AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

The Thermostatic Steam Generator.

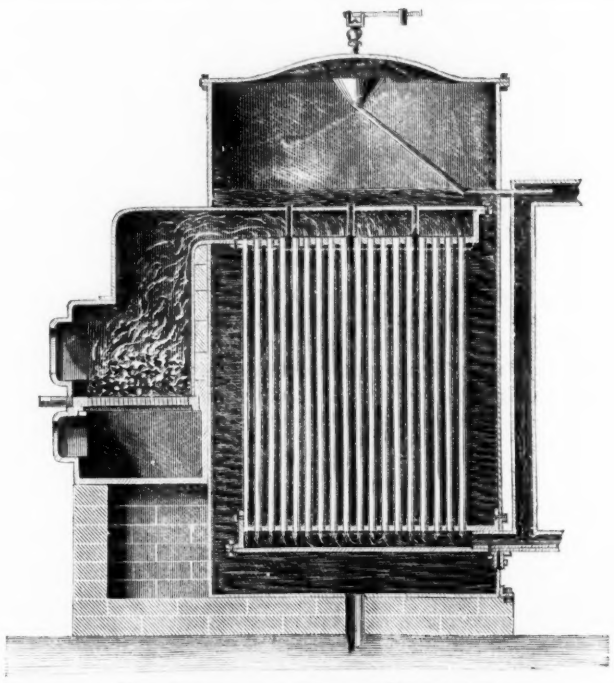
This generator or boiler, one form—the vertical—of which is shown in the engraving, is the invention of J. E. Culver, M. D., of Jersey City, N. J. The end sought in the construction of this boiler is to provide for heating the water progressively, from the time it enters the boiler at the bottom until it is converted into steam, and also to provide for the positive and regular passage of the furnace gases by the heating surfaces, in such a way that as they become cooled they will successively come in contact with correspondingly cool heating surfaces, the gases finally being discharged at a very low temperature from contact with heating surfaces surrounded with the coldest strata of water in the boiler.

As will be seen by the engraving, the gases from the primary combustion chamber, over the grate, pass to a secondary combustion chamber situated directly over the tubes. Provision is made for supplying heated air to the second chamber, in which the combustion commenced in the first chamber is completed.

This secondary chamber also serves as the upper flue chamber of what is termed "the thermostatic flue system," being connected with the lower chamber by ordinarily arranged boiler tubes.

The hot gases pass downward through these tubes, the coldest, according to well understood laws, first, so that the temperature will be found to gradually diminish from the top to the bottom, where they are discharged through the discharge flue or uptake shown at the side. At the same time the water is supplied at the bottom, rising as it is heated, so that the hottest water is in contact with the hottest heating surface of the tubes. The pipe shown leading from the funnel-shaped mouthpiece in the steam-room of the boiler is for the purpose of maintaining artificial draught.

In cases where heat alone is wanted, all the steam generated may pass through this pipe, and mixing with the discharged products of combustion will utilize the greatest possible percentage of heat in the fuel. For other purposes, if desired, a fan or other means than the steam jet may be used for creating draught.



THE THERMOSTATIC STEAM GENERATOR.

New Machine Tools.

The lathe shown swings 27 inches over the bed and 18 inches over the carriage. The spindle has a hole through the center $1\frac{1}{4}''$ diameter, and a front bearing $3\frac{3}{4}''$x$6\frac{1}{2}''$

The carriage is gibbed its entire length, and is furnished with automatic cross feed and elevating or compound rest.

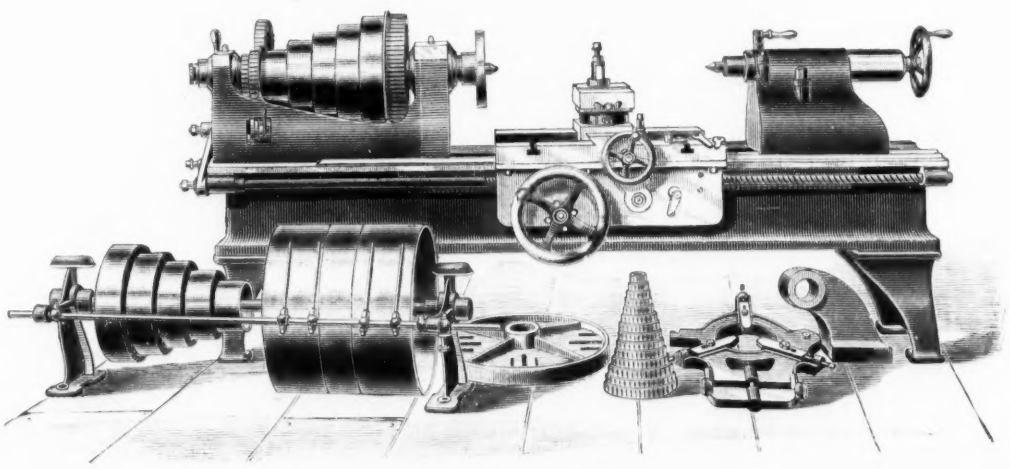
The driving cone is five-graded, for $3\frac{3}{4}''$ belt, the largest diameter of cone being 17″. The feed can be instantly changed from the worm and friction to the screw.

The Slate taper attachment can be used at any point in the length of the bed. Gears are provided for cutting threads from $\frac{9}{16}$ to 16 to the inch.

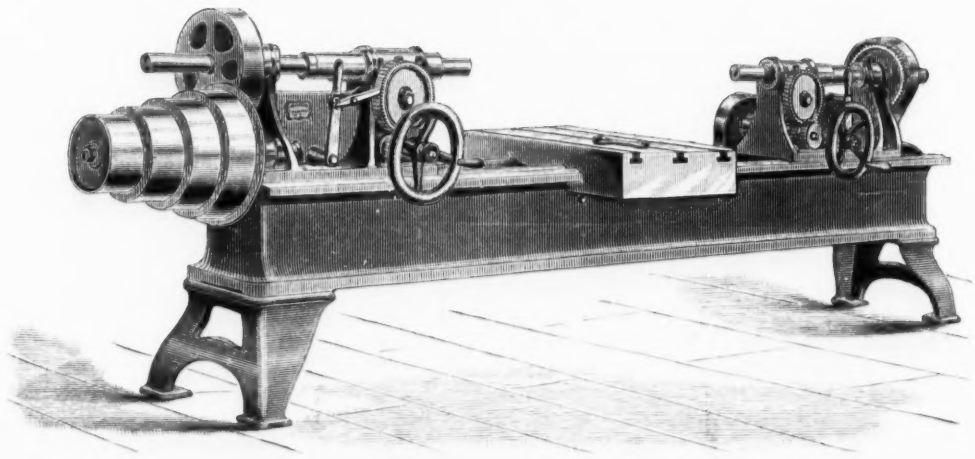
The traverse drill will bore up to 3″ diameter, and face up, both ends at once, to $4\frac{1}{2}''$ diameter.

The table is 24″x30″, and has T slots and $\frac{3}{4}''$ reamed holes. The height from floor to centers is 38″, and from top of table to center of spindles $9\frac{3}{4}''$. The left hand head is fixed, and the right hand head adjustable. The movement of spindle is 12″, with independent feed and stop motion. The countershaft pulleys are 24″ diameter, with 8″ and 4″ faces. Face plates, 12″ and 26″ diameter, and necessary wrenches are furnished. Beds from 8 feet to 24 feet are made.

These tools are made by the Pratt & Whitney Co., Hartford, Conn.



NEW 27 INCH LATHE.



NEW TRAVERSE DRILL.

Boiler Fittings, Boiler Tests and Inspection.

BY GEORGE MARSHALL.

In nearly every boiler shop a large closet or a small room (if a machine shop is connected with the boiler shop, sometimes the tool room is utilized) is reserved for a display of brass goods and fittings. As a general thing these goods are the cheapest to be had in the market, and the dealer who gives the greatest discount from his list is sure of the greatest patronage. The competition between boiler builders makes the purchase of cheap goods not a choice, but a necessity. The unscrupulous builder buys the cheapest goods of every description in order to insure the sale of the boiler with its appliances, and the honest builder is forced to adopt the same tactics to enable him to meet his competitors on equal terms. Steam gauges, gauge cocks, water gauges, check and globe valves, stop cocks and safety valves are all made in the cheapest manner.

I say are all, I should say are generally made in that way. There are yet some manufacturers of these goods who will allow nothing of the shoddy order to leave their works. They furnish a good article and expect, and get, a fair price for their product. But I grieve to say they are not crowded with orders. Their shops are not running day and night to meet the demand.

Lately I have had good opportunities to note the effect of buying cheap globe valves. Out of four dozen ordered and put in one mill, three were found steam tight, the others requiring grinding, a slow process, and if bought from the honest manufacturer unnecessary. Steam gauges are reliable until used; after that they should be tested frequently to insure their correctness. The published reports of the inspection made by the Hartford Steam Boiler Inspection and Insurance Co. show the great unreliability of these instruments, and my own experience as a boiler inspector (not of that company, however), convinces me of the correctness of their reports.

The safety valve is supposed to be as its name denotes, an element of safety. Too often it is, however, a source of danger. Some of these valves are made exclusively of iron. Lately a brass seat is put into pretty much all of them. In the iron valves the moisture will cause corrosion, the valve becomes fast to the seat, and if the steam gauge and safety valve are both out of order, the boiler weak from corrosion, channeling or age, an explosion is the result. One out of a hundred of our engineers of to-day will raise his safety valve lever daily to satisfy himself that the valve will work when required; the other ninety-nine "have no time to attend to it."

Alluding to safety valves, another source of danger is in their being entirely too small for the boiler on which they are placed. The law governing the manufacture of boilers for marine purposes distinctly specifies that the valve area shall be in

proportion to the grate surface; or to use the exact language of the law, "Safety valves * * * * shall have an area of not less than one square inch to two square feet of the grate surface for common valves; but with a valve approved by the supervising inspectors, or any other when the lift will give an area of one half that due the diameter of the valve, the area shall not be less than one-half of one square inch to two square feet of grate surface." This, or a similar rule, should be adopted by boiler builders, or insisted on by steam users, in fact should receive legislative attention to insure its adoption.

It frequently happens that a boiler is used partly for heating and partly for running an engine. In this case the steam pipe is connected directly to the safety valve, and the size of safety valve is regulated solely by the size of steam pipe required on the engine. In case of over-pressure, the valve area is entirely inadequate, and as a consequence the boiler is unnecessarily loaded and sometimes strained.

Your correspondent, W. H. H., speaks of the man-hole plates of boilers, no two being alike, and thinks it would justify the appointment of a National Commission under the cognizance of the Metric Bureau. I thoroughly agree with his ideas in that respect, although I do not entirely agree with him in other things. Perhaps the suggestions made in the AMERICAN MACHINIST, together with the transactions of the American Society of Mechanical Engineers, may in time cause a radical change to be made in this respect.

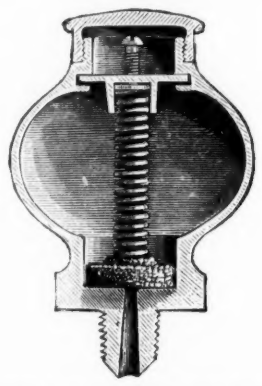
I do not, as a rule, think it policy to interfere with the industries of the state or nation by enactment, yet the vast amount of money invested in boilers, and the number of lives exposed to the effects of explosion, makes laws of some kind in relation to boiler building and using an imperative necessity. Space in our larger cities is every day becoming more valuable, and the side-walks, in many instances, are used as covering for the boiler underneath, which supplies heat to the building or power to elevator or machinery. Imagine the havoc the explosion of such a boiler might cause in any business avenues, or fashionable promenade, yet such an explosion is within the bounds of possibility. In some of our cities the inspection of boilers within the city limits is insisted upon by law.

In some cases the inspectors appointed under city law and under the old state inspection law were appointed through the influence they possessed at primary elections; not through any knowledge they possessed of a steam boiler. Some of these inspectors frankly admitted they could not tell the difference between the locomotive type and the ordinary horizontal tubular boiler, when appointed. The hydrostatic test which they applied was not always the best way to determine the safety of the boiler. I personally made repairs on the boiler of an East River ferry boat where a common slate pencil was pushed through the bottom of the boiler within two months after the boat and boiler were inspected by the U. S. inspector. It is true the inspector was old and the weak spot between keelsons, where perhaps an inspector was not expected to go, but the fact remains the same. You need not on this account hesitate to cross the East River, as that boat and boiler have passed from navigable life, and new inspectors have been since appointed.

The hammer test is not of itself entirely to be depended upon. Not every man knows the sound caused by a blister, or whether the plate covered with sediment will convey the sand sound as the solid plate. An educated eye and ear, and experience, are the guides and qualities necessary to properly test a boiler, yet how few possess them. internal and external corrosion and channeling, should be looked for, as well as blisters or cracks. The braces should be carefully examined with the eye and hammer, as the deposit of sediment will in many cases prevent a crack from being discovered.

Too much reliance is placed on the glass gauge; the gauge cocks become choked up, and occasionally the pipes leading to the glass gauge also become choked, and the failure to detect this causes a burned boiler. Flues leak and the boiler owner is requested to call in a boiler maker to repair a defect caused solely by a reliance on the glass gauge.

The Bryant Self-Feeding Oil Cup.



In this cup a steel spiral spring, having a metallic disc at its lower end, rests against a thick disc of felt over the oil hole in the stem. The tension of the spring, which regulates the feed, is graduated by the screw at the top. When the machinery is idle, the pressure of the spring prevents the escape of oil, but when the machinery is in motion the vibration of the spring, and a partial vacuum in the cup, forces the oil down through the felt in proportion to the speed of the machinery. If the speed is too fast, the screw is turned down; if too slow, it is turned back.

This cup is sold by Cooke & Co., 22 Cortlandt street, New York.

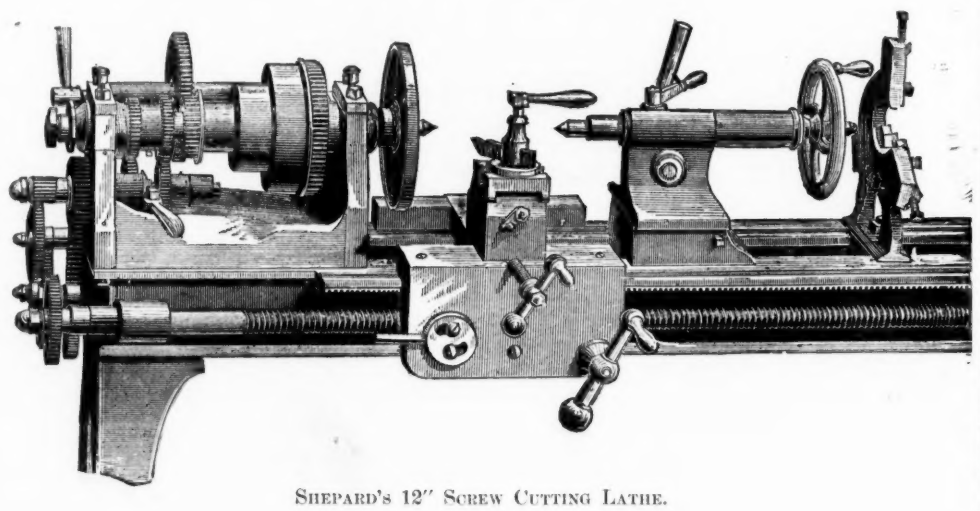
Arranging Boiler-head Pipes.

A correspondent of the *American Journal of Railway Appliances*, who is evidently a locomotive engineer, notes a common blunder of draughtsmen, or pipe fitters which causes much inconvenience to men handling locomotives. In many instances pipes in the cab are so arranged that when pulling the sand lever, or in pulling the reverse lever in the corner, the engineer's hand comes in contact with a hot pipe. This may be a small matter to a man sitting continually in an office, but it is a real annoyance, and often a cause of some suffering to an engineer. These little matters have more to do with making certain engines unpopular than the makers seem to be aware of. Those who understand their own interests do not neglect the minor details which will make an engine uncomfortable to handle. The cocks and valve handles about a boiler head are sometimes arranged so that those used most are hardest to reach, and the fact is evidently overlooked that hands of flesh must grasp the handles. A little care and forethought about this matter would prevent a great deal of wasted profanity.

Shepard's 12-Inch Screw Cutting Lathe.

This lathe is made to run by foot or power. The front V is carried out in front and the screw kept well into the bed, so as to provide substantially a central draught. The Van Horn tool post is used, and the top of carriage is planed true, to bolt work too for boring. The double gear is on a feather, so as to be moved completely out of the way for quick-speeded work. The cone is three-speeded for 1½" belt. The reverse motion is such that right and left handed threads can be cut without stopping.

This lathe cuts standard threads from 5 to 80. It is made by H. L. Shepard & Co., Cincinnati, Ohio.



SHEPARD'S 12" SCREW CUTTING LATHE.

The Fatal Frog.

The death of a brakeman in the yards of the Boston and Albany Railroad, whose foot got caught in a guard rail while coupling cars, calls forth a seasonable protest from the Massachusetts Railroad Commissioners, against the practice of leaving frogs and guard rails in the condition of man traps. Every year many men lose their lives by getting their feet caught in guard rails and frogs, when a little care on the part of railroad companies would prevent such accidents. In the West, where we need to go to find railroad enterprise, nearly all railroad companies fill the guard rail opening with a block of wood, which effectually prevents accidents of this character. The blocks are inexpensive, being made from scrap-wood cuttings. Beyond the Mississippi, railroad managers do not consider they can afford to leave preventable man-traps that will take the lives of their men. When self-interest will not induce Eastern railroad managers to take ordinary precautions to prevent accidents to trainmen, whose occupation is dangerous at best, the screw of the law should be applied in the interests of suffering humanity.

Workingmen and their Employers.

We often think that a better feeling would exist between workingmen and their employers in this country if the latter would take more interest in the physical welfare of the former. Too often the men are paid their wages, and the employer neither knows nor cares what becomes of the money—whether it goes to the savings bank or to the saloon. Too often employers manifest no interest whatever in the home life of their workmen, neither knowing or caring whether or not they have homes at all, nor whether they live in clean streets, with decent surroundings, or in dirty alleys, with indecent surroundings. This is not as it should be. There would be fewer strikes and more contented, and consequently better workmen, if employers would always recognize the fact that those who work for them are human beings, with wants and sympathies like their own. Tens of thousands of our workingmen do not live as cleanly and as comfortable lives, nor as moral lives, as they would live if their employers would systematically provide for them good homes and clean surroundings, or help them to a way by which they could themselves provide them.—*Bulletin American Iron and Steel Association.*

Cooke Locomotive Works.

The Cooke Locomotive Works, Paterson, N. J., are building a group of heavy narrow-gauge engines for the Denver and South Park Railroad. Business is very slack with this company. During last year they did a good business, the following list of engines having been turned out:

3	16"x24" passenger engines.
18	17"x24" " "
4	18"x24" " "
5	19"x24" " "
15	18"x24" mogul engines.
27	20"x24" consolidation.
20	20"x30" mastodon.
20	15"x18" narrow consolidation.
2	16"x24" " "
5	18"x24" ten-wheel.
10	17"x22" mogul switching engines.
4	16"x24" " " with tender.
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Better Lagging Wanted.

Several years ago a master mechanic made a great many experiments with a small Baldwin locomotive, running on light passenger service, for the purpose of ascertaining means for increasing the economy of operating. It was observed that when the engine was running close hooked, drops of water were frequently thrown from the stack. The trouble did not amount to priming, it seemed rather an indication of wet steam condensing in the steam passages. Several methods were tried to abate the evil. Relief cocks were fitted to the exhaust passages, and were left open when the engine was working, but that did not entirely stop the water throwing. The cone and netting were taken out of the stack, and that permitted the water to be thrown clear of the train, but as the engine could not be run regularly that way—this was before the extended smoke box came into use—some other means had to be tried.

The wood lagging was then removed from the cylinders and a lining of hair felt put next to the cylinders, and the wood put back. The cavities in the saddles, between the steam and exhaust passages, were filled with cement and sawdust, and a sheet-iron plate bolted to casting to prevent the non-conducting covering from falling out. This was found to be a complete remedy for the water throwing.

A great many locomotives suffer constantly through defective cylinder lagging. The wood, that is almost universally used, shrinks up after a few months' use so as to admit a free circulation of air and the chilling winds of winter take away more heat in this way than is popularly understood. So soon as cold weather comes round complaints begin that the coal supplied to the engines is bad, and there is difficulty in making steam. In many instances the difficulty experienced in getting engines to steam arises from the fact that they are using up a great deal more than they do in warm weather, owing to the heavy drain of heat taken away by badly lagged boilers and cylinders. Probably no improvement that could be made on the ordinary locomotive would yield such a bountiful return, in the way of economy, as a good non-conducting lagging applied to boiler, fire-box, steam chest, and cylinders.

Pig Iron Statistics.

The *Iron Age* publishes the condition of the blast furnaces of the United States, January 1, of the present year, as compared with January 1, 1883. Following is a summary:

Furnaces.	In Blast.		Out of Blast.	
	1883.	1884.	1883.	1884.
Charcoal.....	123	78	128	169
Anthracite.....	169	109	64	122
Bituminous....	138	101	88	125
Total.....	430	288	280	416

The capacity of the furnaces in blast, as

compared with a year ago, is as follows:

	Capacity in Blast. Jan., 1883.	Capacity in Blast. Jan., 1884.
Charcoal.....	13,700	8,936
Anthracite. ...	39,340	28,824
Bituminous....	53,144	45,365

Mr. James M. Swank, Secretary of the American Iron and Steel Association, has collected statistics which do not agree with the above. Mr. Swank's figures, published in the *Bulletin*, are as follows:

Fuel Used.	In blast Jan. 1, 1883.	In blast July 1, 1883.	Furnaces Jan. 1, 1883. In	Out	Total.
Anthracite..	161	125	118	104	222
Charcoal....	129	98	84	156	240
Bituminous	127	111	105	116	221
Total.....	417	334	307	376	683

The production of pig iron for 1883 was 5,146,972 net tons, against 5,178,122 net tons in 1882.

"At the close of 1882 there were in the United States 687 completed blast furnaces, and at the same time there were 27 furnaces in course of erection. During 1883 there were 13 new furnaces completed—10 coke, 2 charcoal, and 1 anthracite, and 17 furnaces were either burned or abandoned—12 charcoal, 4 anthracite, and 1 bituminous. At the close of 1883 we had 683 completed furnaces in the country, and the information which we have received shows that at that time there were in course of erection 19 furnaces —12 coke, 3 charcoal, and 4 anthracite, some of which are included above in the furnaces under construction at the close of 1882."

Measurements in China.

A writer in the *North China Herald* gives some curious information respecting the foot measure in China. At present it varies largely in different parts of the country, and according to different trades; thus the foot of the carpenter's rule at Ningpo is less than ten, while that of the junk builders at Shanghai is nearly sixteen inches. But a medium value of twelve inches is not uncommon. The standard foot of the Imperial Board of Works at Peking is twelve and a half inches. A copper foot measures, dated A. D. 81, is still preserved, and is nine and a half inches in length. The width is one inch. The small copper coins, commonly called *cash*, were made of such a size, sometimes, as just to cover an inch on the foot rule. In the course of two centuries it was found that the foot had increased half an inch, and a difference in the dimensions of musical instruments resulted. Want of harmony was the consequence, and accordingly, in A. D. 247, a new measure, exactly nine inches in length, was made the standard. Among the means employed for comparing the old and new foot are mentioned the gnomon of official sun dials, and the length of certain jade tubes used according to old regulations as standards. One of these latter was so adjusted that an inch in breadth was equal to the breadth of ten millet seeds. A hundred millet seeds, or ten inches, was the foot. The Chinese foot is really based on the human hand, as is the European foot upon the foot. It strikes the Chinese as very incongruous when they hear that we measure cloth, wood-work, masonry, etc., which they regard as especially matters for the hand, by the foot. Of the jade tubes above mentioned there were twelve, and these formed the basis for the measurement of liquids and solids four thousand years ago. They are mentioned in the oldest Chinese documents with the astrolabe, the cycle of sixty years, and several of the oldest constellations. It is likely that they will be found to be an importation from Babylon, and in that case the Chinese foot is based on a Babylonian measure of a span, and should be nine inches in length.

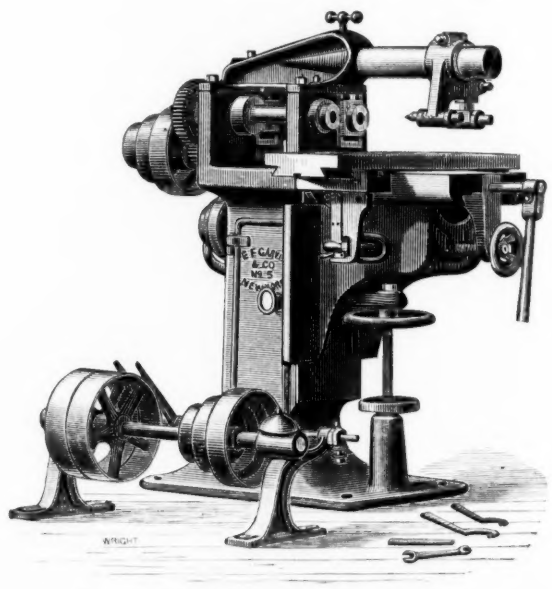
Leather Car Wheels.

A French contemporary mentions that a French inventor has devised a method of making car wheels from hides, and that a manufacturer has tried the process and found it successful. Untanned buffalo hides are used. They are cut into strips and built up into a disk, which is made solid by heavy hydraulic pressure. The body thus formed is turned slightly larger than the tire, into which it is forced by pressure. This process of making car wheels is not greatly different from the plan followed in preparing paper wheels. The hides would be much more costly than paper, and we do not see how material of that kind would be any better adapted for a wheel center than compressed paper pulp.

Garvin's Two-Spindle Milling Machine.

We illustrate with this a new milling machine, manufactured by E. E. Garvin & Co., 139 Centre Street, New York, which possesses some features worthy of note. The machine has two spindles, one of which is fixed, and the other so arranged that it can be raised or lowered by a fine worm-gear and screw adjustment. This makes the machine valuable where it is desired to take both the roughing and finishing cuts at one setting of the work, the finishing cut being taken by the adjustable spindle. Both spindles are geared, and each has an outside center support adjustable upon the heavy arm shown.

The knee and table adjustment, together with the feed work, is similar in design to that of the regular line of milling machines made by this company. Weight of this machine, as shown, is 1,800 pounds.



GARVIN'S TWO-SPINDLE MILLING MACHINE.

Our bright contemporary, *Tech*, takes exception to our recent article on the Chicago Limited Express being called the "fastest train in America." We were aware that other trains made a faster run for short distances; but when we regard that train as a continuous run from New York to Chicago, it has the right not only to be called the fastest train in America, but perhaps the fastest train in the world.

The *English Mechanic and World of Science*, after giving a summary of our recent article on the running of the Chicago Limited Express, says: We think that most railway men will agree with us that this journey of 912 miles in less than 26 hours will compare well with any run in Great Britain, when the conditions are considered, and it is sufficient evidence that the locomotive engine in the United States has reached a high degree of excellence.

Discussing Locomotive Subjects.

Mr. J. A. Hill, master of the Royal George Lodge of Locomotive Firemen at South Pueblo, Colorado, in a private letter to us mentions that the members of his lodge, which numbers upwards of one hundred, have become deeply interested in mutual improvement. They hold weekly entertainments, where something connected with the locomotive is introduced by a chosen member, and the subject is discussed by the others. As these men are the future locomotive engineers of that district, they have engaged in the proper work to put themselves in the front of their calling. Debates of that kind cannot be held among young men without renewed interest in their work being developed. Awakening of that kind is needed all over the country, and those who come under its influence are fortunate among their fellow-workmen. Many others are deeply interested in encouraging this spirit of self-help which is animating the South Pueblo firemen. The seeds which are sown in these weekly meetings will, no doubt, bring forth fruits in the shape of skill and knowledge, which will save thousands of dollars monthly to the railroads in Colorado.

The Bursting Strain in Revolving Wheels.

BY CHARLES T. PORTER.

I take pleasure in responding to your request for a plain explanation of the nature of the bursting strain in revolving wheels, and a formula for their safe construction.

What is commonly called centrifugal force is in reality such a simple matter that it is surprising how those who understand it can make the mystery of it that they do. There is nothing else that so much needs a correct and intelligible definition.

Haswell says: "All bodies moving around a center, or fixed point, have a tendency to fly off in a straight line: this is *centrifugal force*." After reading this, how much more does any one know about the matter than he knew before? It does not tell why a body tends "to fly off," nor in what direction it tends "to fly off." Altogether, it is a model of what a definition ought not to be, or, rather, of what is not a definition.

Trautwine says: "Centrifugal force is that with which a body, while revolving around a center, tends to fly off in a radius, or direct line drawn through said center and the body." The fault with this definition is that it is not true; there is no such tendency. Every one can see the drops of water fly from the face of a grindstone, and observe that they leave the surface on tangential lines, at right angles with the radius. Trautwine states this in a note, but draws a distinction that has no existence between what the body tends to do while it can't do it, and what it does the moment it can.

The fact is, that in order to get a correct idea of the reality that is described by the term "centrifugal force," we have got first to get the expression itself out of our minds. It is a misnomer, that leads to confusion of thought. As Grant is reported to have said respecting Hooker's famous battle in the clouds, that the description was correct with two exceptions, "there were no clouds, and there was not any battle," so we are obliged to say with regard to centrifugal force, that it is not centrifugal, and it is not a force; with these exceptions this expression also is correct.

I suppose by this time somebody may want to know what centrifugal force *is*. This question can be answered in four words. It is the inertia of matter; nothing more nor less than the resistance which matter always opposes to a force exerted to put it in motion from a state of rest. But how can the rim of a revolving wheel be said to be in a state of rest? A brief explanation will make this plain.

Unhindered motion is always in a straight or direct line. A moving body must move in a direct line, unless some force is exerted upon it to change the direction of its motion. Now each particle of matter in the rim of a wheel in motion, if the bond that holds it to the center were broken, would move on in a straight line, in the direction it was moving at that instant, and all these straight lines would be tangents to the circle, as the water flying from the face of the grindstone perfectly illustrates. But while this bond holds, each particle is being continually deflected from a direct line of motion, and compelled to travel in a circle. At every point in its path it is moved directly towards the center around which it is revolving. This second motion is exactly at right angles with the direction in which its momentum would carry it if it were free. The latter is tangential, and the former is radial. Now, the force drawing the body towards the center acts upon it precisely as if it were at rest, because it is exerted at right angles with its line of motion at that instant. The body resists this deflection precisely as a body at rest resists being put in motion, and that resistance is what is called centrifugal force. That is all there is of it. It varies with different rates of deflection, according to the law of inertia, namely, directly as the square of the velocity imparted to the body in moving through a given distance towards the center. The application of this law causes the force required to produce the deflection to vary directly as the diameter of the circle at a given rate of revolution, and as the square of the speed in any given circle.

Centrifugal force may then be properly defined in either of two ways, namely, as the tendency of a body at rest to continue in that state, or as the tendency of a moving body to move in a direct line. It is plain then that it is not a force, and that it is not centrifugal, since the body has no tendency "to fly off in a radius," but only to proceed peaceably on its way. The mode of computing the force required to produce this deflection from a direct line of motion in revolving bodies will be given in another paper.

Inventor of the Steam Plow.

The *Scottish American Journal* publishes some particulars regarding the life of the Rev. Wm. Fisken, who was the inventor and patentee of the first successful steam plow. Mr. Fisken was a native of Scotland, and, although educated for the church, his natural tastes leaned towards mechanics, which he industriously studied. He had a brother who also inherited mechanical tastes, and a curious circumstance about the invention of the steam plow was, that both brothers, although living a long distance apart, invented the plow at the same time, and both wrote to the same attorney, on the same day, asking him to obtain a patent on the invention. He also invented ingeniously arranged appliances for transmitting the power to the plow, which did much to increase the value of the main invention. Mr. Fisken was for many years Presbyterian Minister of a Northumberland Parish near Wylam, where George Stephenson was born. He died a few weeks ago, having reached the age of seventy years.

The total membership of the National Association of Stationary Engineers, Jan. 18th was 1176, an increase of 200 since last report. Since that date a local association has been chartered at Waterbury, Conn., with 25 members, this makes thirty-one local associations.

Making Cutters for Involute Gear Teeth.

BY FRED. J. MILLER.

It has been suggested to me that showing in detail the operations of making a cutter for involute gear teeth according to the method shown in the AMERICAN MACHINIST of December 29, 1883, would be valuable to those for whom it is intended. In this article nothing will be said of "sines," "tangents," "chords" or "arcs," but they will be present just the same.

Suppose a gear wheel is called for, to have 40 teeth of 8 pitch. The pitch diameter of the wheel will be 5″; outside diameter $5\frac{1}{4}$″. The thickness of tooth at pitch line will be .196″, the working depth of tooth .25″, and the amount to be added to depth of tooth for clearance .019″.

The disk to be used for shaping the cutter for this gear, and for all others of the same pitch diameter, regardless of the pitch, will be 5÷4=1.25″. Having made the disk we next rough out the cutter, and then we may use the edge of the disk for taking a light finishing out over the periphery of the cutter, as shown in Fig. 1. Now, before changing the position of anything, it is evident that in order to bring the center of the disk opposite the pitch line of the cutter, it will need to be moved in just half the diameter of the disk, =.625″, plus half the working depth of the tooth =.125″, plus the clearance =.019″. This distance altogether amounts to .769″. Now, there is a certain distance to be subtracted from this amount in order to get the correct position of the disk; and this distance, as explained in the former article, is found by multiplying the pitch diameter of the wheel by .0313, which in this case amounts to .1565″. Now, it is evident that in order to place the disk in the proper position for shaping the cutter, it is only necessary to move it in from the position shown in Fig. 1, a distance equal to .625″+.125″+.019″−.1565″=.6125″. Having done this it only remains to feed the disk laterally, first on one side and then on the other, until the cutter is reduced to the proper thickness.

It will be noticed that this method does away with the use of the line drawn upon the holder to set the disk in position by. This I think is desirable, because it simplifies the process, and admits of closer work. It is no easy matter to determine when the cutter is of exactly the right thickness, because the measurement must be made on the curved surface of the cutter, and moreover so as to exactly coincide with the pitch line. Of course it is easy enough to set a micrometer or vernier caliper to the right thickness, but it is very difficult, if not impossible, to determine when the caliper goes down on to the cutter just far enough to reach the pitch line. If it does not quite reach it the cutter will be too thick, while if it goes below it the cutter will be too thin.

For overcoming this difficulty I would suggest the gauge shown in Fig. 2. It is made of sheet steel, and has a rectangular notch in one side, the depth of which equals half the working depth of the tooth, plus the clearance, while the width equals the thickness of the cutter at the pitch line. The manner of using the gauge is shown in Fig. 3, which shows that it comes in contact with the cutter at the three points, so we may feel sure that the cutter is precisely the right thickness at the pitch line. It is only necessary to provide one gauge for each pitch regardless of the number of teeth or size of wheel the cutter is intended for. When the gauges are to be used very much they should be hardened and ground, otherwise the corners will soon wear away and the gauge be incorrect. When this does happen, however, it is only necessary to remove enough metal from the edge of the gauge to bring the corners up sharp, then by removing a like amount from the bottom of the notch the gauge is again the same as when new.

It has been remarked to me, "Yes, it is easy enough for you to *figure* the distance the disk is to be moved, but how are you going to move it the exact distance?" Having shown that the figuring is easy enough, perhaps I can show that the practical part of it is just as easy.

Those who have a lathe with a collar on the cross-feed screw graduated to read to .001″, will probably turn the screw the given number of graduations, and proceed in the belief that the exact position has been reached. In this, however, the chances are that they will be mistaken. A graduated collar is reliable if the screw is exactly the correct pitch; but, even if it is so when new, it will not be so when old and worn. I have seen a cross-feed screw having a graduated collar attached, the thread of which was worn to about half its original thickness.

Now, supposing this screw to have eight threads per inch, the error in moving the tool-rest from a position where so much as one thread of the nut engaged with an unworn part of the screw, to a position where the nut would be all on the worn part, would be at least 1-64″.

In the absence of the graduated collar, or in order to avoid its errors, if it be present, I suggest the use of the device shown at *a*, Fig. 4. It consists of a clamp adapted to the cross slide of the lathe, as shown. This can be clamped at any desired distance from the tool-rest. There is a steel pin fitted into it, having a head resembling the end of the screw of a micrometer caliper, both in shape and finish. Fitted to the tool-rest is a corresponding pin, as shown. Now, while our disk remains in the position shown in Fig. 1, we move the clamp, *a*, up towards the tool rest, so that the steel pins are about $\frac{1}{4}$″ apart, and clamp it there by means of the set screw shown. Now, take an ordinary small pair of inside calipers, and caliper the distance between the pins. Next set a micrometer caliper, so that the inside calipers will fit it. Now, suppose, upon reading the micrometer, we find the pins are .262″ apart. As we wish to move the tool-rest in just .6125″, it only remains to set the micrometer to .262″+.6125″=.8745″; then adjust the inside calipers to the micrometer, and move the tool-rest in until the calipers again pass between the points. In this way it is easy for any one accustomed to such measurements to come within .004″ of any desired movement of tool-rest.

This method may be applied to a great variety of jobs requiring exact distances between given points. By its use very accurate straight-line graduating can be done, or a small jig may be clamped to the tool rest, and by means of suitable boring tools in the live spindle holes may be bored for the bushings with almost any required degree of accuracy as to distance from each other. The same principle may also be applied to milling machines and grinders for the production of gauges and templates, and for other purposes, which will suggest themselves to the tool-maker or machinist.

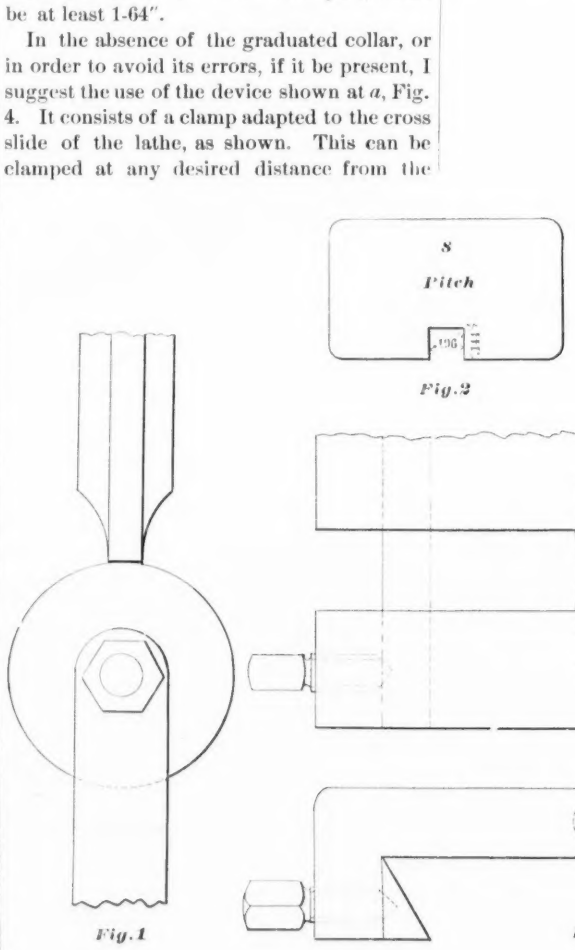


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Car Builder's Club.

The monthly meeting of this club was held in the rooms in Liberty street on the evening of January 17th. There was a large attendance of members, and of parties interested in "Car Wheels and Axles," which was the subject for discussion. Several makers of cast iron wheels were present, and one of them opened the proceedings by reading a paper on "Cast Iron Wheels" in which he appeared to say everything known in favor of that form of wheel. In the discussion that followed it was acknowledged that there is really no method of testing a cast iron wheel which shall demonstrate whether or not it is strong enough to stand the service to which it will be subjected. Some of the speakers were disposed to believe that the proper way to make a cast-iron wheel was to use the best selected iron; but one who had extensive experience in making wheels boldly asserted that the character of the iron employed had not so much influence on the strength of the wheel as the skill and care exhibited in making and cooling the casting.

When the subject of paper wheels was under discussion, a wheel maker asserted that nine tenths of the people in this country, who hear about paper wheels, believe that the paper material comes in contact with the rail. One member believed that the time is fast approaching when no passenger cars shall be run without steel tired wheels. He had run steel tired wheels for 14 years under his passenger equipment, and they have had no accident from a tire that did damage to the train. He held that in case of a steel tire breaking it would generally hold on to the wheel, while an iron wheel would fly in pieces. He has wheels that have run 500,000 miles and are running yet; and from the record these wheels have made, he believes that steel tires are cheaper than chilled iron wheels.

Locomotives for Spain.

The Rogers Locomotive Works are building for the Valls, Villanueva and Barcelona Railway, in Spain. These engines are for a narrow gauge road. Three of them are eight-wheel passenger engines, and three are moguls. The moguls have a peculiarity in the way they rest on the springs. The weight behind is carried by the four back drivers. Two springs carry the weight, and they are hung in reverse position, one at each side of the fire-box. To the frame is bolted a heavy bracket, which answers as a saddle. The band of the spring pushes on the bottom of this bracket, and hangers at the end of the springs connect with a long equalizer, which extends above the main frame, and rests on stirrups placed on top of the driving boxes. The equalizing bar is deep and thin, and the arrangement admits of a slightly wider fire-box than could be got by hanging the springs in the usual way. The forward driving wheels carry their own share of the weight without any equalizing arrangement.

Brakes on Mountain Grades.

From the rules governing engineers and other employes in using brakes on mountain grades, issued to their men by the Northern Pacific Railroad Company, we extract a few paragraphs. The water brake referred to is the Chatelier brake, an old French invention which causes a jet of water to be injected into the cylinders when the engine is run with the motion reversed.

MOUNTAIN GRADES.

Before starting up or down grades which exceed one hundred feet per mile, and one half mile in length, examine brakes and air apparatus carefully.

Going down grade, examine the shifting links, nuts, bolts and all connections of same, to insure their being in order for use in reversing engine, and the use of water brakes.

On very long and steep grades it may be necessary to change the automatic to straight air brake. Engineers must be familiar with the manner of doing this.

On down grades *keep control of the train.* Reduce speed by letting off a little air and holding it. Apply brakes in full only when obliged to do so.

WATER BRAKES.

Water brakes should be used only when going down heavy grades, and always with great care.

First, *have engine in motion without steam, have cylinder cocks full open and keep them open;* pull reverse lever one notch back of center, or out, with throttle dead shut. Then give the water cock a sixteenth or one-eighth of a full turn open; see that the steam comes from the cylinder cocks freely. Then regulate the speed with lever, pulling it back. The speed must be regulated by the reverse lever altogether and with no change in water cock. A too free use of water is dangerous to cylinder heads, and will force water out of smoke stack. In shutting off water brake throw reverse lever ahead and shut off water.

Light engines when fitted with both air and water brake may be best controlled by setting water brake moderately, and using the air or tender brake to regulate the speed. In cases of necessity the water brake and train air brake may be used together; *always be careful*, however, in setting the water brake.

DRIVER BRAKES.

The driver brakes are intended to use on mountain grades only in cases of necessity. A too free use of the driver brake heats the tires of driving wheels, and expands them so that the brake is useless.

Make the brake system a study, and keep familiar with all its details. Especially is this necessary on the part of engineers, firemen and other employes of the Machinery Department.

The Paterson Iron Company, Paterson, N. J., have recently erected the necessary plant for rolling iron and steel plates. They have got two reverberatory furnaces for heating the blooms and a set of heavy rolls for turning out the plate.

Power is supplied for the rolling operations by a plain slide-valve horizontal engine, built by the Fort Pitt Foundry, Pittsburgh, Pa. The engine is very massive, having cylinders 44″x48″ and a built fly-wheel 24 feet in diameter and weighing 45 tons. The main shaft is 18 inches diameter, the steam pipe is 10 inches diameter, and the whole engine weighs 221 tons. The boilers that supply

steam to the engine are placed over the iron furnaces and are heated by the waste gases.

In the forging works belonging to this company there is a stern post in course of construction which weighs eight tons. This, and a shaft, which also weighs eight tons, go to one of the steamers of the Morgan line being built by William Cramp & Sons, Philadelphia. In the machine shop, one of the lathes was turning a very heavy shaft for the Astor steam yacht.

The Indicator Diagram.

By F. F. HEMENWAY.

COMPUTING THE HORSE POWER.

The lines of the diagram enclose a figure, the length of which represents the stroke of the piston, and the height, measured to the scale of the spring used in the indicator, the pressure operating to move the piston and a factor in calculating the indicated horse power of the engine. Thus the upper line, in which is included all the enclosing lines, as a whole, that are described while the piston is moving ahead, represents by its distance from vacuum, or an imaginary line usually considered as located 14.7 lbs. below the atmospheric line, the pressure operating to move it, while the opposing force is represented by the lower line of another diagram, simultaneously taken from the other side of the piston, and the mean distance apart of these lines, measured by the scale of pounds, is the average pressure moving the piston, less the pressure against the opposite side, that resists its progress: in other words it is the *mean effective pressure.* Any means then by which the average distance apart of these lines may be determined, will give the mean effective pressure. This is true in all instances except where expansion is carried so far that the expansion curve crosses the line of counterpressure, in which case the lines of the diagram will enclose two distinct figures, the mean height of one of which must be subtracted from that of the other; or when compression is carried to such an extent as to form a loop at the termination of the return and beginning of the forward stroke. The first of these conditions is only likely to obtain in the instance of non-condensing engines, cutting off short, as when lightly loaded, and the second is of still rarer occurrence.

The amount of work done on one side of the piston may differ materially from that done on the other side, and almost invariably does differ to some extent. For this reason, in calculating the horse-power developed, it is necessary to have diagrams from both sides, when the average mean effective pressure of the two will be that required. Although the lines called the upper and lower lines of the diagram do not really belong together, no error, in computing the power, will arise from considering them as doing so, but on the contrary it tends to greater accuracy, as compared with a process in which they are considered separate, besides simplifying the operation.

MEASURING THE MEAN EFFECTIVE PRESSURE.

Altogether the most accurate and expeditious way to measure the mean effective pressure represented by the diagram is by means of the planimeter or averaging instrument, but as such an instrument is not always at hand it may, by careful working, be very accurately done by dividing the diagram into a number of equal parts, say ten, as in Fig. 2, measuring the height of each division, adding these measurements together and dividing the sum by the number of divisions. The only reason for making the number of divisions ten is for convenience; some prefer to make the number twenty, as tending to greater accuracy. Referring to Fig. 2, the height of each division can be measured by a scale of pounds, the measurements added together and divided by ten, the result appearing in pounds; or the measurements can be made by a scale of inches, the sum multiplied by the scale of the spring and divided by ten, giving the result as before. As tending to greater accuracy, however, it is advisable to make the measurements continuous. For this purpose a strip of paper is sometimes used, which is carried from one division to another, the measure of each being pricked or marked beyond the preceding one, so that the distance from the end of the strip to the last mark will represent the sum of the ten measurements. Instead of the strip of paper I have used, very satisfactorily, the little "home made" gauge represented in the engraving. I have seen only this one, which was improvised at a time when it was thought advisable to measure a large number of diagrams both by the planimeter and by some other method. It consists of a black walnut strip *a*, 12″ long, ¼″ wide by ½″ deep, one edge beveled and a piece of metal, *b*, at one end to furnish a well-defined line from which to measure. To this strip a light metallic clip or slide *c*, is fitted to spring over with sufficient friction to hold it in place. The knob, *d*, is for convenience. In using this the end of the piece *a* is brought to the lower line of one of the divisions and held in place with one hand while the slide is moved to the upper line, then it is placed on the next division with the slide on the lower line and the piece held while the slide is again moved to the upper line, and so through the ten (or whatever the number may be) divisions. When the measurements are all taken the distance of the slide *c* from the end will be the combined height of all the divisions. Thus in Fig. 2 this distance is 7.075 inches the number of divisions ten and the scale of the indicator spring 40; hence the mean effective pressure is

$$\frac{7.075 \times 40}{10} = 28.3 \text{ lbs.}$$

THE HORSE POWER.

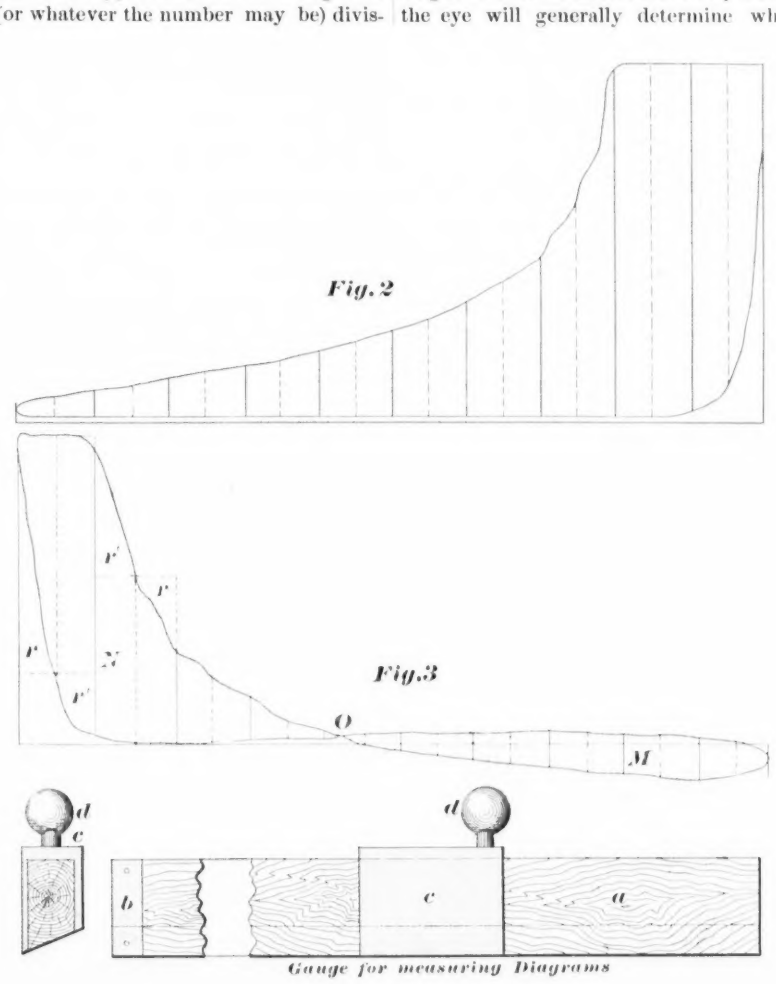
The data required to find the indicated horse-power from a pair of diagrams, are: The diameter of cylinder, stroke of piston, diameter of piston rod, revolutions per minute and scale of indicator spring. In this instance the diameter of cylinder is 18.3 inches, stroke of piston 42 inches, diameter of piston rod 3⅛ inches, revolutions per minute 72, and the scale of spring 1″=40 lbs. The mean net area of the cylinder (the total area less one-half the area of piston rod) is 259.18 inches, and the piston speed 504 feet per minute, so that if the mean effective pressure of the diagram from the other end is the same as this the indicated horse-power is

$$\frac{259.18 \times 28.3 \times 504}{33{,}000} = 112.$$

Fig. 3 represents a case in which the pressure falls, by expansion, below the line of counter-pressure, crossing the latter at *O*, from which point to the end of the stroke it is plain that the pressure urging the piston forward is less than that resisting its progress. To get the mean effective pressure in such an instance it is evident that the resistance indicated by the part *M*, of the diagram must be deducted from the forward pressure, indicated by the part *N*. This is conveniently done by measuring the combined height of the four divisions included in *N*, similarly measuring the six divisions of *M*, and subtracting the latter from the former. The combined height of the four divisions of *N* is 2⅜″, and of the six divisions of *M*, ⅞″, then 2⅜″—⅞″=1¾″, which multiplied by 40 and divided by 10 gives a mean effective pressure of 7 lbs. If the gauge previously referred to is used it is only necessary to measure the divisions in *N* by moving the slide ahead, then continue measuring those of *M* by moving the slide back, which will perform the subtraction.

PRECAUTIONS IN MEASURING THE DIAGRAMS.

It should not be inferred that measuring the divisions of the diagram at their centers, as on the broken lines, will always be correct. It would be more nearly true to say that it will never be correct. It is the mean height of each division that is required, and the eye will generally determine whether this will result from measuring at the center. In Fig. 2, measuring the height of the ten divisions on the center lines, will give a mean effective pressure of 28.81 lbs. or about ½ lb. too much, and in Fig. 3 it will give 6.5 lbs., an amount too small by more than 7 per cent. This will be better appreciated by an examination of the first and second divisions of Fig. 3, in each of which it is evident that the parts r′ that ought to be measured, but are not included in a measurement on the center line, are not equal with the parts *r* that are measured, but ought not to be. An examination of other divisions of both Figs. 2 and 3 will afford additional evidence that the practice of drawing the center lines only and taking their measurements as conclusive is likely—almost certain—to lead to error. By drawing the boundary lines of each division, then when any doubt exists drawing the short horizontal lines (as near *r*, *r′*) the spaces, *r*, *r′*, can be compared, by the eye, after a little practice, with great exactness. Additional short horizontal lines can be drawn above or below these, to indicate the point to which to measure to equalize the spaces, or where the case presents dfficulties a division can be subdivided any number of times, and the height averaged in a way similar to that in which the height of the diagram is averaged.



Gauge for measuring Diagrams

LETTERS FROM PRACTICAL MEN.

A Wrinkle in Pattern-Making.

Editor American Machinist:

Some of the writers in your paper, I think, are first class, and hit nails that want hitting pretty squarely on the head. I hope the remarks about pattern-making will bring out some points. I will start the ball with what I think is an original wrinkle of my own.

Having occasion to get up patterns for the box frame of a roller mill, in order to make the same cheaply and as quickly as possible, I had a solid pattern of the body made. This was rammed up in the flask, the pattern withdrawn, and the mould carefully trimmed and covered with parting sand, except where there was any drawing to be done. At such points a very smooth, hard, thin paper was secured to the mould with cut tacks. This being done, the "drag" or "nowel" was put in place, and the bars fitted carefully into their places and secured, when it was filled and rammed up, the whole turned over and the cope lifted off, leaving an exact reverse of the pattern in the drag. Now, as it was intended that the casting was to have a nearly uniform thickness of ¼ inch, a little tool like the sketch was made, and used to

make grooves all over the surface of this counter-mould, where it was required to remove the sand. These grooves being ¼ inch deep, the paring down of the surface to that extent was a simple matter. When it was completed, and all the necessary venting, gating, etc., attended to, the cope was put in place and the pouring successfully accomplished. This gave us the first iron pattern, with only one-quarter the cost of a hollow wooden one, and was repeated in the cases of three other different sizes which were required subsequently. A rim and the four journal boxes, which are attached, were made as in ordinary patterns, and left in the sand after the solid pattern was drawn.

This idea can be made use of in a great number of instances where an iron pattern is wanted, or only a few castings from a wooden pattern. W. S. B. LAWRIE.

Toronto, Ontario.

"Firemen vs. Coal Shovelers."

Editor American Machinist:

Not long since, in your editorial columns, I read an article under the heading "Firemen *vs.* Coal Shovelers," and it brought to my mind a circumstance that came under my observation not very long ago. The superintendent of an establishment running two 4′x16′ boilers wanted to hire a man to take charge of and fire them nights, for about three months, during the winter. The engineer recommended a man, an excellent fireman and reliable in every respect, who would take the job for thirty dollars per month, and board, but the superintendent thought the wages entirely too high; said he could get a man for twelve dollars and board, that could shovel coal as good as any thirty-dollar man. The engineer said nothing more, and the cheap man was hired. He lasted just six weeks, and at the end of that time he allowed the water to get entirely out of one of the boilers, and it was so badly burned that it cost five hundred dollars to repair damages, besides loss from having to shut down the works for two weeks, while repairs were being made.

Since the above occurrence the man recommended by the engineer has been hired, and the boilers have had more work put upon them, so that at the present time they are doing fully one-third more work than before, and without any increase in the coal bill. In this case the best man is decidedly the cheapest. ENGINEER.

Stopping a Train by the Air Brake.

Editor American Machinist:

In your issue of Feb. 2d you give a brief account of a remarkable accident to a train on the Bradford, Bordell & Kenzua Ry.,

where a train running down a steep grade by a ruptured oil tank, the oil becoming ignited by the locomotive fire, enveloped the train, causing loss of life. Your article in relation to the accident conveys the impression that the train could not have been properly provided with braking power, or the result might have been different. Looking at the matter from our standpoint, we cannot see how the result could have been much different under the same circumstances. The train approached the oil tank round a sharp curve, and on a descending grade (100 ft. to the mile), and judging from the fact that the train (or engine) jumped the track, they must have been running fast. When the train struck the oily track we think it could not have been stopped under any circumstances, or with any brake system. On such a grade we think the train could not be checked until it had run a long distance. It would be in our opinion wrong for the engineer to stop his train, if it had been possible for him to have done so, until he got through the fire. There is a possibility that this engineer might not have been aware of the extent of the catastrophe, running perhaps faster than the burning oil would ignite, and being intent on his duties ahead, he might not have realized the real magnitude of the situation. Of course, we only say that this may have been the case.

In regard to your remarks that the hand brake is still in use, we will say that there are no engineers of experience who put any dependence on hand brakes. They are only applied as an auxiliary, or to use when cars are detached; and all passenger engineers, when the air brake gives out on the road, find it very difficult to make their time on account of lack of brake power. Engineers whistle sometimes in case of accident, when their brakes have all been applied, and they do this from habit; or, perhaps, become excited, and do not realize what they are doing.

EAMES VACUUM BRAKE CO.

Watertown, N. Y,

Building Locomotives in Repair Shops.

Editor American Machinist:

Your copy of the AMERICAN MACHINIST of January 19th speaks of building new locomotives in repair shops. It puts me in mind of an instance of that kind that came under my own observation some few years ago. While working in the repair shop of the Indianapolis & LaFayette Railroad the master mechanic came to me and said: "Ben, I am going to build an engine that will eclipse any thing that comes into this town." Then he commenced to tell me all the new ideas that he was going to develop. It was to be a ten-wheeler—that is, six drivers and a truck. The middle drivers were to have no flanges, and were to have four inches lateral motion. He was going to put an offset in the side frames to admit of it; put on a Bissell sliding truck, and several other things too numerous to mention. I says to him, calling him by name, "Go and make correct drawings of it before you commence, then you will see what you have to contend with." He scorned the idea of making drawings—said anybody could work after drawings, but it took a mechanic to work without them. I said: "You go ahead, and you will see how you will come out." Well, we did go ahead. The offsets were put in the frames about 4 inches, and I made the valve gear—the only good thing about her. The guides were of the horizontal kind, and everything went all right until we put the wheels under her. Then we found the forward crankpin would not pass the guides by half of its length. New guides and back cylinder heads had to be made, the guides had to be put vertical, then a new set of crankpins had to be made. After a long time we got her done, and took her out to try her. As we were going around a short curve near the shop, the middle drivers dropped off the track. We then found the lateral motion business would not work. We took her in the shop, and put in a new set of driving boxes with one very thick side, to take out the lateral motion. As the offsets were in the frame and could not well be taken out, the spring-saddles consequently bore all on one side of the driving box, and of course the box wore crooked. After she was out of the shop she never did any good. They kept her switching around the yard awhile, and she eventually found her way to the scrap heap.

That engine must have cost the company three times as much as a first-class engine would. Another thing, the clerk took the men's time every day, so as to keep a record of the time spent on every engine, and whenever a man was at a loss to know what he worked on, he would say, "Charge the rest to the No. 3,"—that was the number of the engine. A great deal more time was charged to her than there ought to have been.

Some time after the engine was finished I said to the master mechanic, calling him by name, "Don't you recollect my telling you to make drawings of that engine before you commenced it? If you had done it, you would not have had all this trouble, and the company would not have sustained the loss. It don't pay to make new machinery when you can buy it cheaper and better than you can make it. People are now working into specialties, and they that do can always undersell any one else in their line of goods."

BENJ. F. HETHERINGTON.

INDIANAPOLIS, IND.

An Example of Close Measurements Under Difficulties.

Editor American Machinist:

Recent correspondence with Friend Brooks, who first discovered the present appearance of the comet of 1812, has led me to look up some figures, and reduce them to comprehensive proportions, with a result so interesting that I present them in the belief that they will interest others—not specially because of the facts they impress, but because they point out what has been done in the way of fine measurements under difficult circumstances.

If we let a pea, $\frac{1}{4}''$ in diameter, represent the earth, it would require a ball 28′ in diameter to represent the sun, and these, as situated in the heavens, would be 242 feet apart, the earth swinging around the sun in a circle 484 feet in diameter. Proportionately, the moon would be represented by a shot 1-16″ in diameter, swinging around, the representative of the earth, 7″ away.

If this little imaginary system were set up on a platform, the platform would need to be 100 miles in diameter to accommodate the planet Neptune, and the nearest of the fixed stars would be quite one-third of the way to the moon.

Think over how these measurements are determined. The little pea is divided into 360 parts, and one of these parts measured and from this the size of the pea is determined. Here ends the extent of human proof, and this is the base line from which all greater measurements are established. From the two sides of this pea the distance to the 28″ ball of fire, 242 feet away, must be determined. This, with telescopes of our present size, fixed upon a solid base, with the cross hairs but a fourth of an inch apart, would be difficult enough; but, when we realize that the telescopes would be but a five-millionth of an inch in length and the fifty-millionth of an inch in diameter, mounted on the pea always in motion, the problem seems less easy.

Having determined the distance to the sun within a limited degree of certainty, then the earth's orbit may become a base line of, say, 484 feet in length; but here the problem becomes complicated fourfold. The earth not only turns upon its own axis, but travels around in an ellipse, instead of a circle, and on a plane differing from its own plane of rotation.

With this new base line of 484 feet, it would be, with our present instruments, a fairly good piece of civil engineering to determine the distance of Neptune, fifty miles off, though the astronomers do it with their fifty-millionth of an inch instruments, mounted on this $\frac{1}{4}''$ *terra firma*, rolling around at a rate of once in a day, and traveling around for six months to get to the other end of the base line, and not stopping for the observer to get sight of them. Not only the fifty miles has the astronomer to measure, but he is with only this base line to tell whether the nearest fixed star is one-third or one-half way to the moon.

Wonderful as all these things are, they are no more wonderful than the accuracy with which the return of the comet of 1812 was predicted.

The comet may be seen now (January 25th) without the aid of a glass in the South-West soon after sunset. It was first discovered on this trip by Mr. Brooks, at a greater distance from the earth than any other comet was ever before discovered, and by a telescope of his own make.

Mechanics may take an interest in this, as Mr. Brooks is a mechanical draughtsman, and was at one time with Mr. Corliss at Providence.

The figures I have given above are not strictly accurate, but, unless I have made some great blunder, they are near enough for comparison.

JOHN E. SWEET.

Setting a Slide Valve Without Tools.

Editor American Machinist:

A question is asked in a recent number of the AMERICAN MACHINIST about how to find the dead center on a vertical engine without any tools but a two-foot rule. If that man can add a jack-knife to his kit of tools, I can give him full particulars as to valve setting for a common vertical slide-valve engine, and it applies to a great many horizontal engines also. I have been there with a limited tool chest, and managed to set the valves as correctly as the ordinary run of slide valves are set where the most approved appliances are used.

My plan was to take a water bucket and set it down on the floor, with its edge resting against the pulley. Then I moved the engine till the cross-head was within two inches of the end of the travel, scratched a line across cross-head and guide, and, putting the rule across the bucket as a guide, made a scratch on the pulley. My next operation was to turn the engine till the scratch on the cross-head got back to that on the guide; then I repeated the operation of making a scratch on the pulley. A center mark, made half-way between the two scratches on the pulley, will be the true center. The opposite center may be found in the same way.

Now, I put the engine on one of the centers, which I locate by means of the bucket and rule, and take off the steam-chest cover. With the blade of the knife I measure the extent of lead opening, manipulating the eccentric and rod to get it as I wish. Then I turn to the other end, and go through a similar performance. I may have to try the ends several times before the opening is made right, but a little patience and time will put the valves in as good shape as they are generally found in the most pretentious slide-valve engines.

MCDUFF.

The Air-Brake on Long, Steep Grades.

Editor American Machinist:

Your reference—on page 8, of January 26, AMERICAN MACHINIST—to the presence of British railroad men at the opening of the Northern Pacific Railroad and their perplexity respecting the change from "automatic" to "straight air," in descending long, steep grades, is likely to leave the reader with an unfair impression of the air-brake, when considered in its present state of perfection.

Though the statement to the English engineers may have been correct for the occasion, viz., that in descending long, steep grades it is customary to use straight air, yet the Northern Pacific Railroad, or any other road, is not any longer obliged to change to straight air on descending grades of any length or steepness.

The comparatively very simple invention, by which the automatic air-brake is extended in applicability to the steepest and longest grades is one of intense interest, both for the tardiness with which the necessity of it came to be realized and for the wonderful power it has in extending the recognized great advantages of the automatic brake to such portions of railroad as most need it, and which, previously, it was supposed must do without it. The automatic brake can now be used on any part of any ordinary railroad.

For the benefit of any reader who may not be posted respecting the distinction between the "automatic" and the "straight air," permit me to say, briefly, that in the Westinghouse system the straight air consists in compressing air into a reservoir, usually suspended under the foot-board of the locomotive, from which a pipe extends to the brake cylinders, one on each car. A cock placed in this pipe enables the engine man in the cab either to send air back to the brake cylinders from the reservoir, or to cut off the reservoir and to discharge air from the brake cylinders. It is easy to see that by this means, when all is in good order, air may be maintained at any pressure in the brake cylinders, and the brakes correspondingly set. Absence of pressure gives freedom from brakes. Also, it is plain that with this system the bursting of a hose connection between cars, or the occurrence of other gross leak, would render the brake useless. Now, the worst place for a brake to become suddenly useless is evidently on a long, steep grade, full of sharp curves, such as found in the Rocky Mountains.

The automatic brake is so called from the fact that if a train parts, breaking a hose connection, or if any serious leak occurs, the breaks automatically go on, bringing the train or its parts to rest. This feature is realized by placing an auxiliary reservoir on each car, along with the brake cylinder, maintaining pressure in it by communication with the main reservoir through such a pipe as is used in the straight air; and further, by placing at each auxiliary reservoir a "triple valve," to which the entire automatic action is due. In this arrangement, air is maintained at full pressure through main supply pipe and auxiliary reservoir, but not in the brake cylinders, until the application of brakes is needed. Then the engine man turns the cock against the main reservoir, and to cause escape from the main pipe and auxiliary reservoir. Now, as the air attempts to escape from the latter, the triple valve is thrown by and with the current until it shuts off the escape from the auxiliary reservoirs, through the main pipe, and turns it into the brake cylinder, thus putting on brakes with full force. A slight escape of air gives a gentle application of brakes.

With this arrangement it is plain that if a hose breaks, or a train parts, all portions of the train are brought to a standstill. In this arrangement the brakes cannot be applied unless the auxiliary reservoirs are to some extent charged with air; and then only by making the pressure in the supply pipe less than that in the reservoirs. On long, steep grades the demand for long-continued application of brakes consumes the air from the auxiliary reservoirs, so that eventually there remains no brake power until these reservoirs are recharged. This recharging raises the pressure in the main pipe and throws off brakes; and they must so remain till recharging is stopped, and the main pipe again lowered in pressure.

During this recharging with the brakes off the train will race, and the limiting grade is that at which this racing attains to a dangerous speed. For the automatic brake, as above outlined, this limit occurs on long grades of about 100 feet per mile, more or less, according to expertness of the man at the brake-valve handle.

On all roads east of the Rocky Mountains, but little if any difficulty has been experienced in using the automatic air brake as above, but on mountain grades ranging from 100 to 200 feet per mile and over until recently, it has been necessary to use straight air.

But the Westinghouse Company has recently brought out a "pressure-retaining valve," which renders the automatic brake available with safety for any grade. This is simply a "back pressure valve" to be placed on the triple valve escape, and by which the escape of air from the brake cylinders is arrested at some determinate pressure to which the valve is adjusted—say 10 lbs. per square inch.

With this pressure-retaining valve in

action, the pressure in the brake cylinder is prevented from falling below the 10 lbs. while recharging the auxiliary reservoirs, and this is probably sufficient to prevent the occurrence of dangerous racing on grades up to 200 feet per mile. If not, the 10 lbs. may be made 15 or 20.

These valves may be turned into and out of action by brakemen, as required by the grade occupied. All, or any needed number of them may be turned on. That this valve may be accessible while the train is in motion, pipe may extend from the triple valve to any suitable point on either passenger or freight car.

Thus it appears that the automatic brake *may* be "maintained in service," the only modification required to change it from that condition in which it could not be thus safely maintained in service being the addition of the simple weighted valve holding down on the air exit from the brake cylinder and triple valve, a device which costs but a few dimes per car. This is an excellent example to show how extremely simple an invention may be, and yet work wonders in service. In effect, the caging of a ball upon the end of an exit pipe for air, suffices to change the condition of a train, in descending a terrific mountain grade, from one of positive danger to one of almost absolute safety.

S. W. ROBINSON,
Professor Mechanical Engineering,
Ohio State University.

The Hammer.

BY JOSHUA ROSE, M. E.

(From a Lecture Delivered Before the Franklin Institute.)

THE TWIST HAMMER.

In Fig. 5 we have the twist hammer, used for precisely the same straightening purposes

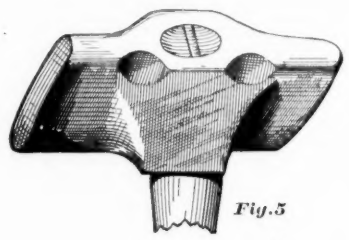


Fig. 5

as the long cross-face, but on long and heavy plates, and for the following reasons:

When the operator is straightening a short saw he can stand close to the spot he is hammering, and the arm using the hammer may be well bent at the elbow, which enables him to see the work plainly, and does not interfere with the use of the hammer, while the shape of the smithing hammer enables him to bend his elbow and still deliver the blows lengthways, in the required direction. But when a long and heavy plate is to be straightened, the end not on the anvil must be supported with the left hand, and it stands so far away from the anvil that he could not bend his elbow and still reach the anvil. With the twist hammer, however, he can reach his arm out straight forward to the anvil, to reach the work there, while still holding up the other end, which he could not do if his elbow were bent. By turning the twist hammer over he can vary the direction of the blow the same as with the long cross-face. * * * *

Both these hammers are used only to straighten the plates, and not to regulate their tension, for you must understand that a plate may be flat and still have in it unequal strains; that is to say, there may exist in different locations internal strains that are not strong enough to bend the plate out of truth, as it is, but which will tend to do so if the slightest influence is exerted in their favor, as will be the case when the saw is put to work. When a plate is in this condition, it is said to have unequal tension, and it is essential to its proper use that this be remedied.

The existence of unequal tension is discovered by bending the plate with the hands, as has been already mentioned, and it is remedied by the use of the dog-head hammer, shown in Fig. 6, whose face is rounded so that the effects of its blow will extend equally all around the spot struck. It will readily be understood that the effects of the blow delivered by the smithing, or by the twist hammer, will be distributed as in Fig. 7,

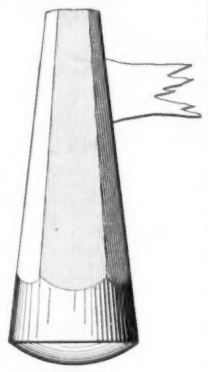


Fig. 6

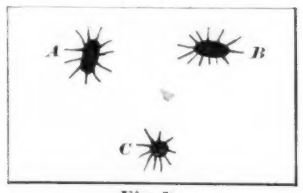


Fig. 7

at *A*, *B*, while those of the dog-head will be distributed as at Fig. 7, at *C*, gradually diminishing as they pass outwards from the spot struck; hence the dog-head exerts the most equalized effect.

USE OF THE DOG-HEAD HAMMER.

Now, while the dog-head is used entirely for regulating the tension, it may also be used for the same purposes as either the long cross-face or the twist hammer, because the smith operates to equalize the tension at the same time that he is taking down the lumps; hence he changes from one hammer to the other in an instant, and if after regulating the tension with the dog-head he should happen to require to do some smithing, before regulating the tension in another, he would go right on with the dog-head and do the intermediate smithing without changing to the smithing hammer. Or, in some cases, he may use the long cross-face to produce a similar effect to that of the dog-head, by letting the blows cross each other, thus distributing the hammer's effects more equally than if the blows all lay in one direction.

REGULATING THE TENSION OF CIRCULAR SAWS.

In circular saws, which usually run at high velocity, there is generated a centrifugal force that is sufficient to actually stretch the saw and make it of larger diameter. As the outer edge of the saw runs at a greater velocity than the eye it stretches most, and therefore the equality of tension throughout the saw is destroyed, the outer surface becoming loose and causing the saw to wabble as it revolves, or to run to one side if one side of the timber happens to be harder than the other, as in the case of meeting the edge of a knot.

The amount of looseness obviously depends upon the amount the saw expands from the centrifugal force, and this clearly depends upon the speed the saw is to run at, so the saw straightener requires to know at what speed the saw is to run at, and, knowing this, he gives it more tension at the outside than at the eye; or, in other words, while the eye is the loosest, the tension gradually increases towards the circumference, the amount of increase being such that when the saw is running the centrifugal force, and consequent stretching of the saw, will equalize the tension and cause the saw to run steadily.

In circular saws the combinations of tight and loose places may be so numerous that as

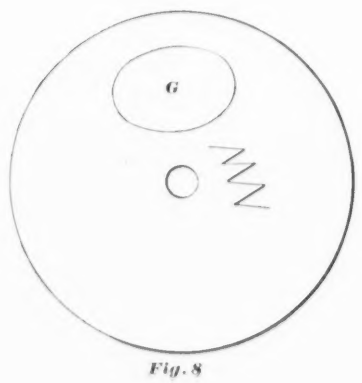


Fig. 8

the smith proceeds in testing with the straightedge he marks them, drawing a circular mark, as at *G*, in Fig. 8, to denote loose, and the zig-zag marks to indicate tight places.

PRACTICAL EXAMPLES.

To cite some practical examples of the principles here laid down, suppose we have in Figs. 9 and 10 a plate with a kink or bend

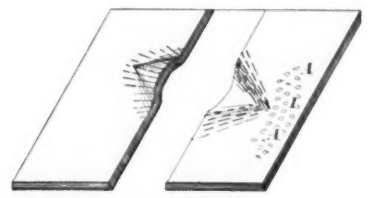


Fig. 10 *Fig. 9*

in the edge, and as this would stiffen the plate there, it would be called a tight place. To take this out, the hammer marks could be delivered on one side, radiating from the top of the convexity, as in Fig. 9, and on the other as shown radiating from the other end of the concavity, as in Fig. 10, the smithing hammer being used. This would induce a tight place at *A*, Fig. 9, which could be removed by dog-head blows delivered on both sides of the plate. Suppose we had a plate with a loose place, as at *G* in Fig.

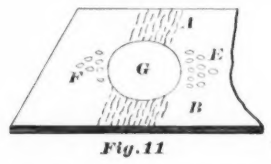


Fig. 11

11. We may take it out by long cross-face blows, as at *A* and *B*, delivered on both sides of the plate, or we might run the dog-head on both sides of the plate, both at *A* and at *B*, the effect being in either case to stretch out the metal on both sides of the loose place *G*, and pull it out. In doing this, however, we shall have caused tight places at *E* and *F*, which we remove with dog-head blows, as shown. If a plate had a simple

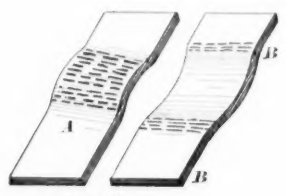


Fig. 12

bend in it, as in Fig. 12, hammer blows would first be delivered on one side, as at *A*, and on the other side, as at *B*. A much more complicated case would be a loose place at *G*, in Fig. 13, with tight places at *H*, *J*, *K*, and *L*, for which the hammer blows would be delivered as marked, and on both sides of the plate. Another complicated case is given in Fig. 14, *G*, *G*, being two loose places, with

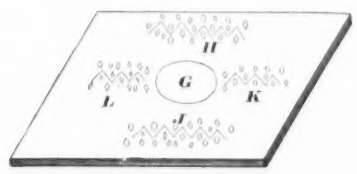


Fig. 13

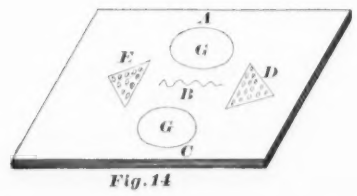


Fig. 14

tight places between them and on each side. In this case, the hammering with the long cross-face would induce tight places at *D* and *E*, requiring hammer blows as denoted by the marks.

I have here some examples to show you how plainly bending a plate will show its tight and loose places. Here is a rectangular piece of plate that is loose in the middle, and the straight edge lies flat on it; but if I try to bend the middle of the plate downwards with my hands, you will see that it goes down instantly, the straight edge showing a large

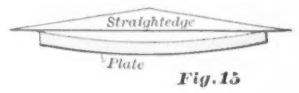


Fig. 15

hollow in the middle, as shown in Fig. 15, the same thing occurring with the straight edge tried on both sides of the plate. Here is another piece that is tight in the middle, and when I try to bend its middle downwards in precisely the same way it comes upwards, and the straight edge shows it to be round, as in Fig. 16. In the first case the middle

Fig. 16

actually moves, because it is loose; in the second place the edges move, because they are loose.

Here we have two circular saws, one tight and one loose at the center, and here you see the same thing occurs; for if I bend the loose one down, it goes down, leaving a wide space between the eye of the saw and the straight edge; while, if I try to bend the middle of the tight one down, it refuses to go there, but goes at the outside, leaving the straight edge resting on the middle. Here, again, then, the part that is loose moves the most. These examples are simple cases, but they impart a general knowledge of the principles involved in the skillful use of the hammer, and have, I hope, illustrated the fact that, in seeking for the secrets of skill, we find them to consist largely of easily-understood mechanical principles.

The following extract from a letter, recently received by us from the foreman of an Arkansas machine shop, will probably interest apprentices: "I have been delayed in sending my subscription this year, because I wanted all of our apprentices to take your paper also; so I got up the club you find inclosed. With what experience I have had, I find it is a waste of time and patience to try to teach a boy a trade who is too poor to take a mechanical paper and read it, and yet can afford to take such papers as the *Police Gazette*, read dime novels, blood-and-thunder stories, use tobacco and whisky, and spend his nights hanging around saloons and gambling houses. I shall encourage our boys to read as much as possible, and those who 'cannot afford it' had better learn some other trade. I have no use for them."

Protesting Against Cheap Labor.

From the *Times* we learn that a well-known lawyer in Wilkesbarre, Pa., maintained in the course of a public lecture that the people of the district were right in petitioning Congress to prevent the importation to this country of Hungarian and pauper labor by corporations and wealth that their coffers may grow fat, regardless of the condition and welfare of the American citizen. "To-day," said the speaker, "many of our mines are running on half time, and the ore mines at Reading are paying but sixty-five cents a day, and many families are destitute in consequence. What is the cause? The cause is Hungarian and pauper labor brought into competition with the men who demand fair wages that they can live in decency, and not in infamy and disgrace, as do the pauper laborers of Europe. By virtue of this cheap labor, the markets are glutted with over-production." The practice which some of our miners and iron makers are following of bringing over the cheapest labor under contract, is contrary to the spirit of our institutions, and unless something is done to check it, demoralization of our whole labor market will result. There is no objection to men coming here voluntarily and entering into competition with other laborers, but the practice of bringing them over in droves for the special purpose of depressing the price of labor is intolerable. Many men are working at the heavy labor connected with mining for less than a dollar a day, and yet a continual struggle is being made to reduce this pittance.

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New York Railroad Commissioners' Annual Report.

The New York Railroad Commissioners' Annual Report for 1883 contains a mass of valuable information on railroad matters; and the recommendations made regarding needed legislation are very judicious so far as the mechanical branches of railroad operating are concerned. A valuable feature about the report is the compilation of facts respecting the operating of railroads which will influence public opinion in judging as to where weak points may be. In the matter of accidents alone, we have authoritative data that show where the greatest danger in train operating is encountered, and the knowledge given is the first step towards devising proper remedies. The fact that the Railroad Commissioners are keeping a record of all accidents and investigating their causes, cannot fail to have a beneficial influence on railroad management which will result in increasing the safety of railroad operating and travel.

During the past year 322 persons were killed, and 660 injured by railroad accidents in the State of New York. From the reports, we see that coupling cars is the most prolific cause of injury, 23 persons having been killed and 177 injured by that work alone. Grade crossings come next as a cause of accident. Inventors have produced many forms of automatic car couplers which could be put on cars at small expense, and whose use would prevent the greater part of the maiming and loss of life due to coupling cars with the present defective appliances; but few railroad companies have shown any desire to provide this means of safety. The Railroad Commissioners now recommend the legislature to put an end to the procrastination of railroad managers, by enforcing the use of automatic couplers after a certain date. Other sources of danger to railroad employes and travelers which some railroad companies have treated with apathetic unconcern are to be no longer neglected with impunity. The recommendation is made, that no new railroads shall be allowed to cross another at grade without permission being obtained from the Railroad Commissioners, and this board asks for authority to require signals to be erected for the protection of existing crossings, and men to watch them where they consider that precaution is necessary. They also require all trains to stop before passing over a crossing at grade, a source of delay which they may abolish in cases where interlocking signals have been erected that are calculated to provide for the safety of the crossing. In the report, the stub switch is condemned; the use of automatic brakes is recommended, protection for low bridges is called for, and the existing diversity of train rules and signals is deprecated. Legislation is called for to convince railroad companies of the necessity for reform in all these matters.

In their anxiety to provide for the safety of passenger trains, the Commissioners recommend that one brakeman shall be provided for every two cars on all passenger trains. Where good brakes are in use a requirement of this kind is useless and absurd. It is evidently made because there was a lack of brakemen on the train which met with a fatal accident at Hunter's Point, Long Island. The cause of that accident was gross mismanagement all round. They had a worthless brake to start out with, they had badly coupled cars and a conductor without judgment; and now the Commissioners propose to heap useless expense upon well-managed roads because the cumulative blunders of one that was badly managed led to disaster. Our leading roads have trains running for years without a brakeman having to turn a wheel, and when the rare occasion comes where brakemen are needed, the average conductor can be trusted to provide for them without incurring delay or danger.

We are in receipt of several letters from machinists in different parts of the country, inquiring as to the prospects of getting work in some other locality. These letters are from Eastern men asking about the prospects in the West, and from Western men making similar inquiries about the East. It is very difficult to answer such inquiries in a way to be of any practical value to those who ask. We know that good machinists are always getting situations, both East and West. Manufacturers complain that while they can get all the men they want—more than they want—they find difficulty in getting the kind of men they want. We think, as a rule, first-class machinists are able to find work, but when the demand is not brisk they are better able to do so where their abilities are known than among strangers. There is in no part of the country such a demand for machinists as to warrant men in traveling great distances, without good prospects of work before starting.

Disseminating Boiler Explosion Theories.

Several parties in the West have drawn our attention to a long article on "boiler explosions" which recently appeared in the *Chicago Tribune*. The writer of the article alluded to makes out a theory, that what he calls a diaphragm of tallow or other grease sometimes settles on the surface of the water of a boiler, and prevents the generation of steam till some shock comes which breaks the diaphragm, and the whole water in the boiler suddenly bursts into steam with a force which no sheets can withstand. In support of this theory, some cases of boiler explosions are cited, where the writer thought the accidents could not be accounted for on any other theory. The cases used to substantiate this theory were boilers that went up when the steam throttle was opened, or when some other event happened to move the water in the boiler.

There is nothing more in this theory of boiler explosions than there has been in many others, that have done serious injury to public safety by making the uninitiated suppose that accidents of this character are beyond human control. When a boiler explodes under a pressure which had often been carried before without signs of weakness, certain parties are sure to proclaim that some mysterious agency has been at work. In other departments of applied mechanics similar phenomena are of daily occurrence, and pass without comment. A link in the chain of a crane breaks under a lighter load than the chain lifted two hours before; a crank axle breaks, not when the engine is working at its maximum power, but under comparatively light duty; a locomotive axle breaks when the engine is jogging along at quarter the speed it made yesterday. Few mechanics consider cases of that kind mysterious, yet the same laws apply to the rupture of a steam boiler that control the safety of a chain link or axle. Were there anything in the theory advanced by the writer in the *Tribune*, explosions would be most common with boilers likely to have their feed water contaminated with grease. Marine boilers making steam for surface condensing engines are most liable to have grease in their feed water. The greatest number of surface condensing engines are in British steamships, and no explosion has ever happened to a modern marine boiler under control of the British Board of Trade.

We regret that influential papers allow themselves to be made the channel for disseminating pernicious fallacies about boiler explosions. The most eminent mechanical engineers all over the world, and those most experienced in the care of steam boilers, agree that there is no more mystery about the bursting of a steam boiler than there is in the breaking of a propeller shaft. Boiler explosions are most frequent with saw mills, threshing machines, and other boilers handled by incompetent men and permitted to weaken by corrosion and age. There is urgent need for the educating of the general public to the true cause of boiler explosions. Public sentiment might then be used to compel boiler users to have worn out boilers renewed before they went to pieces, hurling destruction and death among helpless citizens. A deplorable sentiment regarding boilers in this country is, that steam users are not held personally responsible for the safety of their boilers. When a house becomes dangerous and liable to fall, the owner is promptly held to account for any damage done, should care not be taken to prevent an accident; but when a boiler, that should have been in the scrap heap years ago, goes into the air, some inspector is blamed for neglect. Should an attempt be made to prosecute any one for damage done by an exploded boiler, there is no difficulty in befogging a jury, thanks to the mystery theories spread broadcast through the public press.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(62) J. L. W., Brooklyn, N. Y., asks: Are there any schools in Brooklyn where mechanical drawing is taught? *A.*—Not that we know of.

(63) J. C., Mallory, N. Y., asks: 1. What can I use to clean and polish iron and steel surfaces? *A.*—Emery cloth. 2. What can I use to black a boiler? *A.*—Asphaltum paint.

(64) C. F. E., Plainfield, N. J., asks: Will you tell me some of the advantages of using diametrical instead of circumferential pitch in gear wheels? I fail to see how one is better than the other. *A.*—The only advantage is in the fact that it is easier to calculate diametrical than circumferential pitch.

(65) O. A., Groton, N. Y., asks: Will genuine babbitt metal answer for the bearings of a punch, to punch 1" holes through wrought iron 1" thick? The main bearings are 6" diameter and 10" long, and the cam bearing 4" diameter and 4" long. *A.*—We think babbitt metal will answer for the main bearings, but not for the cam bearing.

(66) F. B. C., New York, asks: If an engine with cylinder 7x9 is doing a certain amount of work with 50 lbs. boiler pressure, will an engine with cylinder 8x10 require more steam to do the same work, the steam going through a governor in both cases? *A.*—We understand you to refer to plain slide-valve engines. There may be circumstances that will alter the results, but on general principles the large cylinder will use the most steam.

(67) G. C., Victory Mills, N. Y., asks: How can I clean a cylinder head and steam-chest cover of the stains of oil burned on? I have been using oil and emery, but am afraid of its getting into the working parts. I have seen a preparation resembling salt used for this purpose, but do not know what it is. *A.*—We know of nothing better than emery cloth. If any of our readers know of the preparation to which G. C. refers, or any other useful for the purpose, we shall be glad to hear of it.

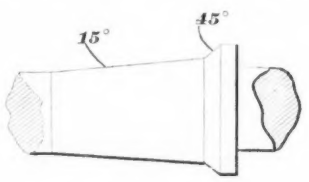
(68) J. S., Corning, Iowa, writes: 1. I have an engine 5"x6". The valve has ¼" outside, and 3-16" inside lap, with a travel of 1⅜ inches. By reducing the inside lap, would it not increase expansion, reduce compression, and hasten release? *A.*—Reducing inside lap will reduce compression and hasten release, but will not affect expansion. The valve has too much inside lap. It should not, with the outside lap named, have to exceed 1-16 inside lap, if any.

(69) W. H. H., Gray, Me., asks: 1. What is the best way of firing small boilers with kerosene or benzine? *A.*—The use of kerosene or petroleum, for fuel, is in an experimental state; we think no one, as yet, is competent to answer your question. We do not recommend that you practice with benzine. 2. I have a boiler 12" diameter by 24" long, with 24 tubes. The shell and heads are made of No. 14 galvanized iron; seam double riveted. How much pressure can I safely carry? *A*—Probably 40 to 50 lbs. We should not recommend, however, that you use it at that pressure until you have tested it with water pressure to at least 75 lbs.

(70) F. D. F., Bonne Terre, Mo., writes: 1. I am foreman in a small machine shop, and sometimes want to make a small brass casting. I melt the brass over a blacksmith's fire and use the same sand as we use for iron casting. My castings are hard and rough. Can I remedy this? *A.*—You should use a finer sand for the moulds. It is possible you heat the metal too hot, which will leave a rough surface. If your castings are too hard, use more copper. 2. There is here a mine pump 150 feet under ground. I want to condense the steam. Can I place a condenser near the pump and divide the suction, using part of it to condense the steam and return the water to the pump, and will there be any saving in fuel in doing so? *A.*—We do not think the plan of a divided suction and condenser will work. You can exhaust directly into the suction, which is sometimes done in mines, where the pressure of exhaust steam is objectionable. You would not be likely to save much if any fuel by doing so.

(71) W. A. A., St. Louis, Mo., writes: In a discussion, A claims that in a sinking pump suspended by means of a rope and working under steam pressure of 80 lbs., the additional strain on the rope will be only that due to the pressure of steam multiplied by the area of the hose that conveys steam to the pump, while B claims the additional strain will be that due to the area of piston multiplied by the pressure. Which is right? *A.*—The pressures in the pump, due to the working, will be equal in both directions, and will not add to the strain on the rope. The only possible addition would be due to the weight of the steam, and the area of the hose multiplied by the pressure.

(72) J. G., ——, asks: 1. What is the proper taper for taper bearings for each end of a hand lathe spindle, and are taper bearings adapted for an engine lathe as well as for a hand lathe? *A.*—We should not suppose you would want a taper



bearing; if at all, only at the front end. The sketch shows a form of taper bearing said to be highly approved. 2. What should be the taper of the center where it fits the spindle? *A.*—There is no uniformity in this respect. 1-20″ taper per inch of length will do very well.

(73) Hanover, Pa., writes: There has been some argument in our shop about setting locomotive valves by the sound of the exhaust. I want to know how you would move the eccentric rods of a locomotive, supposing the heavy exhaust to occur when the cross-head is on the forward center? *A.*—If the heavy exhaust occurs when the engine is working steam towards full stroke, you may effect a remedy by shortening the rods and increasing the lead on the back end, which will accelerate the cut-off. On the other hand, should the heavy exhaust be most apparent when the engine is hooked up close, it may be remedied by the opposite treatment of lengthening the rods, which will reduce the lead opening on the back end. As the lead gives the greater part of the opening when an engine is working at a short cut-off, its reduction will likely reduce the quantity of steam admitted into the cylinder. Experience and judgment are necessary in making changes in an engine's valve motion, and it should not be done except by a man who understands the business.

(74) T. D. A., Dayton, Ohio, writes: We have two 48″x20 foot boilers, and are running a 12″x24″ engine, and heating one building 117x40 feet, and another 100x70 feet, and four stories. We have large wrought-iron tanks of sufficient capacity to store draining from roofs in wet weather, the water from which we use in the boilers. The condensation from coils and radiators is returned, and pumped into the boilers, thus using the same water over and over. We are told that this will injure the boilers. It looks to me as if the water would be better than fresh water. What is your opinion about its injuring the boiler? *A.*—We understand you heat with steam direct from the boilers, in which case there is no reason to fear injury to the boilers. Thousands of heating boilers are in use, some of them having been used for twenty years, in which the condensed water is returned to the boiler, only a few gallons of fresh water being added during the winter, to compensate for leaks. In heating with exhaust steam, returning the drip, sometimes the oil used in the cylinder works injury to the boiler.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gears—G. B. Grant, 3 Alden st., Boston; water motors

Special Machinery—G. D. Lambert, New Haven, Ct.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

James W. See, Consulting Engineer, Hamilton, O.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass

F. VanWinkle, Mech. Engin'r, 22 Cortlandt St., N. Y.

Spanish translations of catalogues, circulars, &c. J. M. Da Rosa, 260 East 3d St., Cincinnati, O.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh, Wells, & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C. C. Hill, 144 LaSalle st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Jack pump and ladder chain machines, 40 to 80 links per minute, direct from coil. The Gaylord, Cross & Speirs Company, Waterbury, Conn.

Machine tools and supplies, steam engines, gas engines, ⅛ to 1 H.P. Send for large illustrated catalogue. Jackson & Tyler, Baltimore, Md.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Wanted—A 50-inch planer, 48-inch engine lathe, 60-inch engine lathe, second-hand, in good order. Address, Box 879, New York City.

H. O. Reinhardt, M. E., Mem. Am. Soc. Mining Eng., Chihuahua, Mex., invites correspondence of man'f'rs of machinery desiring to introduce same in Mexico.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

"Painting and Painters' Materials."
The best book for all who paint, deal in paint, or have painting done. $2 25. For sale by "The Railroad Gazette," 73 Broadway, New York.

BOUND VOLUMES of the AMERICAN MACHINIST for 1880. A limited number for sale at $3.50 per volume, express charges to be paid by purchaser. $4.50 per volume will be charged for 1881 and 1882. AMERICAN MACH. Pub Co., 96 Fulton st., New York.

"HOW TO KEEP BOILERS CLEAN."—A book of seventy-two pages, telling how to prevent scaling, foaming, priming, and burning, with other valuable information, will be sent to any address FREE of postage, by James F. Hotchkiss, 86 John street, New York.

Any of our readers who have complete files of Volumes I. and II. in good condition, bound or unbound, can probably find a purchaser by addressing us, and stating the lowest price they will accept. AMERICAN MACHINIST PUBLISHING COMPANY, 96 Fulton street, New York.

EXTRACTS FROM CHORDAL'S LETTERS, containing nearly 400 pages, 12mo, handsomely bound in cloth. New and enlarged edition, with additional illustrations, many of them humorous and all effective; over 50 in all. Just the thing for a holiday or birthday gift. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Useful Information for Steam Users—A 100-page pamphlet, compiled from the best authorities, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Engineers everywhere should have this work. Send 25 cents in P. O. stamps for a copy. The J. N. Mills Publishing Co., 145 Broadway, N.Y.

Patent "Common Sense" Binder for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address, in the United States, by mail for one dollar. To Canada and foreign countries 75c., the purchaser to pay custom-house duties and express charges. American Machinist Publishing Co., 96 Fulton street, New York.

MANUFACTURES.

S. B. Shivers, Selma, Ala., proposes to establish a bagging factory.

It is reported that a $500,000 mill will be erected shortly at Hopkinsville, Ky.

Moses Strickler, of Bridgewater, Va., will open a foundry and machine shop soon.

Millard Howell, J. F. Stephens, and others, are preparing to establish machine shops at Rome, Ga.

T. A. Perry, of the Plymouth, N. C., Iron Works, is building a new foundry.

The railroad shops at Roanoke, Va., are about to add several hundred men to their force.

Fall River, Mass., will have a new mill in the spring, with 34,000 spindles, to cost $400,000.

The Belmont Mill Company, Wheeling, W. Va., are to build a nail factory in the spring.

Scott & Williams will build a barrel factory, of 125 barrels daily capacity, at Henrietta, Texas.

It is said that the Brunswick and Western Railroad will build new shops at Albany, Ga., the coming season.

Work has been resumed in all departments of the Reading Iron Works. The works employ 1,000 men.

The Winchester Arms Company, at New Haven, Conn., are filling an order from China, for 2,500 muskets.

J. McFarlane, of Chicago, will erect a brick factory, corner Harrison and Clinton streets, at a cost of $12,000.

Frederick Iles, wire-goods manufacturer, 2451 Ridge avenue, Philadelphia, is about to erect a new shop at 1741 Afton street.

The erection of the Litchfield Rolling Mills, at Litchfield, Mo., has been made certain, and work will begin soon.

The new brick machine shop to be erected on Seventh street, Reading, Pa., by the Philadelphia and Reading Railroad will cost $20,000.

Robert Del is building a cotton mill at Rockingham, N. C., to be 320 feet long by 60 wide, and two stories high.

Over $100,000 has been subscribed for the Dalton (Ga.) Cotton Factory. The work of erection will begin at once.

The Racine (Wis.) Wagon and Carriage Company propose to increase their capacity by adding new buildings and improvements.

The Iowa Iron Works, Dubuque, Ia., are about to bring out a new compound condensing engine for manufacturing purposes.

The Improvement Company has been formed in Niles, Mich., for the purpose of securing additional industries, and aiding those desiring to locate there.

A Co-operative Tool Manufacturing Company is contemplated at Paris, Ill. The capital is $25,000. The members of the concern are all practical mechanics.

The Edwards Manufacturing Company, Augusta, Me., contemplate building a large, new cotton mill the coming spring, which will give them double their present capacity.

The Springfield (O.) Machine Company, organized lately, will manufacture largely wind engines and haying tools. The capital stock is $50,000, all paid in.

At Racine, Wis., a new company has been organized to manufacture express wagons and trucks. The works will occupy the building owned by ex-Mayor W. P. Packard.

The Paine Lumber Company have commenced the erection, in Oshkosh, Wis., of a sash door and blind factory, which will be one of the largest in the United States.

The Elyton Land Company, Birmingham, Ala., have offered to donate land for manufacturing sites, and further assist new shops, mills, or factories.

Martinez, Cal., wants steel works, and it is said enough money has been subscribed to start the works. A company has been organized for the purpose.

The Rock Creek Manufacturing Company, of Rock Creek Mills, N. C., has been incorporated, and will manufacture cotton yarns, cloths, and fabrics for milling.

Smith, Myers & Schnier, engines and saw-mill machinery, Cincinnati, O., have moved into their new shop. They employ sixty-eight men, and will, after a time, increase the force one-half.

The Oliver & Roberts Wire Company, Pittsburgh, Pa., will add a wire-rod rolling mill to their works. The building will be 250x150 feet, and will be ready for business about the first of May.

John F. Liebrich, Indianapolis, Ind., has lately established a factory at South and Meridian streets, for the manufacture of taps, dies, &c., and reports a good business.—*Industrial World.*

Five acres of land and $2,000 in money has been donated by the citizens of Wampum, Pa., to secure the promised location of steel works in that place. The project is in the hands of Pittsburgh capitalists.

Smith, Gifford & Co., of Nashville, Tenn., are trying to organize a company with a capital of $100,000, to construct and operate a sorghum, cane syrup, and sugar factory.—*Baltimore Manufacturers' Record.*

J. H. Dunstan, of Roanoke, Va., has formed a company to manufacture agricultural implements on a large scale. Two acres of ground have been purchased for the buildings, which will be begun very soon.

The Shickle, Harrison & Howard Iron Company of St. Louis, are melting about sixty tons of iron a day, and running one pit only. They will shortly increase their melt to 100 tons a day and work three pits.

The Laconia (N. H.) Car Company recently closed a contract with the Government of New Zealand, Australia, amounting to $80,000. It calls for 100 open freight cars, and the order is to be increased to 500 of the same pattern.

Boynton & Plummer, Worcester, Mass., have recently received several large export orders for small shaping machines. They are meeting with good success with those tools which are adapted to both hand and power.

The American Ship Building Company, of Philadelphia, H. H. Gorringe, president, have purchased the Allen foundry, machine shop, and boiler works at Tamaqua, Pa. A considerable force of men will soon be employed there.

The indications now are that it is probable that some industry will soon be started in the old works of the Greenfield Tool Company at Greenfield, Mass. The plant originally cost $50,000, and the works are well located, being near the railroad.

A Co-operative Stove Manufacturing Company is being organized in Buffalo, N. Y., with $75,000 capital. About $35,000 has thus far been subscribed. The shares are $100 each, and no person is to be allowed to hold, govern, or control more than thirty such shares.

At Waterbury, Vt., the Cooley Manufacturing Company—capital, $20,000—have built and equipped a factory for the manufacture of patent sand-boxes, wagon hubs, and axles and iron and brass castings. The factory is 50x80 feet in size, and employs 40 hands.

F. E. Reed, Worcester, Mass., is building machine tools in his new shop, with orders enough ahead to keep running three months steadily. He has just got out a lot of ten new milling machines. They are of two sizes, the larger weighing 2,000 lbs. each, and the smaller 1,200 lbs.

The firm of Logan, Swifts & Brigham, which is fitting up 10,000 square feet of floor area for an envelope factory, at 16 Union street, Worcester, Mass., comprises the selling agent, superintendent, and inventors of the special machinery of the Whitcomb concern, same city.

The edge tool works of A. W. Crossman & Son, at West Warren, Mass., will add sufficient machinery to the plant within the next three months to nearly double the production. Four tilt hammers-two runs of stone, a polishing machine, and several new heating furnaces will form a part of the new machinery to be thus added.

The Holt Manufacturing Company has been organized at Springfield, Mass., to manufacture hardware and mechanics' tools. M. W. Robinson is president; H. W. Wesson, treasurer, and the same and G. L. Holt, directors. The capital is $15,000.

At Beaver Falls, Pa., the file works are shipping 800 dozen files per day. The new wire factory is well under way. The shovel works are in full operation. The new merchant mill of the Hartman Steel Works will be 75x180 ft. The Beaver Falls Steel Works made a shipment of steel shapes to Central America recently.

The Jensen Manufacturing Company will soon be organized at Racine, Wis.—capital, $40,000—to manufacture wagon hardware, and make a general line of iron and brass castings. They will succeed to the business now being conducted By Jens Jensen. The other incorporators are John P. Davis and W. P. Brown.

The new buildings of the Union Iron Works at Potrero, Cal., are well under way, and some of them are nearly completed. The boiler and blacksmith shop is 200x150 feet. The foundry building is 200x100 feet in size. The engine-room is 100 feet square. The chimney rising from the boiler-room is 120 feet high.

The Pond Machine Tool Company, Worcester, Mass., are making a new suspension drill in two sizes. They are also making a shafting lathe, fitted with a patent cutter and a force-pump traveling with the carriage, and an 8½″ double cutting-off and centering machine. They are now working on patterns for a 48″ lathe and a new axle lathe.

Prentice Brothers, Worcester, Mass., are building a new 45″ upright drilling machine, weighing 7,000 lbs., for bridge work; also a special two-spindle drilling machine for a railroad shop. In the latter the drills are 8″ apart, and each has a separate feed and weight. They intend to make the drilling machines for bridge work from 42″ to 50″ swing.

Ryan, May & Latus, 38 Bleecker street, New York, who have carried on the manufacture of church and undertakers' candlesticks for several years, have taken an additional floor, and put in a new engine and tools, for making chandeliers and gas fixtures. They will soon place some new and artistic designs upon the market.

The Car Wheel Works at Marshall, Texas, are turning out 100 car wheels a day, and employ about 400 men. The company runs a furnace, and smelt the greater part of the iron used from native ores. A new furnace is in course of construction at Lou Allen, a few miles from Jefferson, which will give work to 200 men.

Mixer & Byrnes, manufacturers of ice and refrigerating machinery, Brooklyn, N. Y., are putting in two machines in the Lion Brewery, New York; two in Joseph Doelger's brewery, New York; and two for George Bechtel, Staten Island. They have improved their facilities for making and erecting this class of machinery, and are meeting with good success.

William Allen & Sons, Worcester, Mass., are building nine 100 horse-power steel boilers, for the Washburn Iron Company of that city. They are also building several other boilers, among them one to go to the Manuel Training School, Batesville, Va., and one to Brockville, Ind. They have under way seven Victor feed-water heaters. One hundred and thirty men are employed in the boiler shop, foundry, and machine shop.

The H. B. Smith Co., Westfield, Mass. says the Springfield *Republican*, have begun laying the foundation of their new works on the north side of the river, and expect to have the buildings ready for use by spring. They employ 150 workmen, and are much cramped for room in their present quarters. The new buildings will relieve the pressure, and it is not unlikely that in time the larger share of the manufacturing will be done at the "Canada annex."

At a meeting of glass workers in Pittsburgh, Pa., a party, representing capitalists of Toledo, offered to donate ten acres of ground and establish a window-glass factory, bottle house, and fruit jar factory. Capitalists furnish the cash necessary to put the factories in operation, provided that the men go there and take a working interest in the concern. The proposition was accepted. A large number signified their intention of taking stock, and books were opened at once. The factories will be ready for operation by April.

The Denver *Journal of Commerce* says: Our manufacturing interests, or rather the product of our manufactories in the State (Colorado), have nearly doubled in the year. From twelve millions and a half, in 1882, they have gone above twenty millions in 1883. Among the iron workers every hammer and lathe has been busy, and will be during the twelve months to come. The builders and workers in wood see large contracts for them in the future.

Hartmann, Le Doux & Maecker, 134 Pearl street, New York, controlling the American patents for Fox's corrugated boiler furnaces, finding American capital apathetic, are working to form a company among English capitalists, for the purpose of erecting a factory in this country—probably in the neighborhood of Philadelphia—for the manufacture and sale to boiler makers of these furnaces. The new factory will be modeled on the large establishment now making them at Leeds, England. The company is also expected to manufacture and sell to boiler makers parts of boilers which require flanging. The Fox corrugated furnaces are largely used in England for marine purposes, and are said to be equally well adapted for use on stationary and locomotive boilers. They are made of mild steel, and the special points urged for them are increased heating surface and greater strength.

Machinists' Supplies and Iron.

NEW YORK, January 31, 1884.

The market has undergone little change during the week. The situation in the screw market is unsatisfactory, and there is said to be considerble cutting of prices going on.

In iron, a moderate volume of business has been in progress in the open market. A hopeful feeling is gaining ground at important iron centers, and the market presents a steady tone. No. 1 X Foundry, at $20 is not so easy to buy as a fortnight ago. We quote No. 1 X Foundry $20 to $21; standard Lehigh brands, special makes, such as Crane, are held at $21 to $21.50, No. 2 X Foundry, $19 to $19.50; Grey Forge, $16.50 to $17.50.

In Scotch pig there is a slight improvement in prices, and sales are easier for small quantities.

Antimony is in moderate demand, but held firm, Hallett's, 10¾c.; Cookson's, 12c.

Copper—Ingot has ruled steady, but quiet, Lake, 14¾c to 15c. Quotations for manufactured copper are unchanged.

Tin—The market is firm, with a tendency towards higher quotations. Banca, 20c.; Straits and Malacca, 18½c. to 18⅝c.

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"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue.

Wanted—A situation, by a first-class iron planer' References given, if required. Address O.W. Gates' Shannock's Mills, R. I.

Wanted—Situation as superintendent, by a thorough draughtsman and mechanic; 17 years' experience. Good references. BOX X, care AM. MACHINIST

Wanted—Situation in a machine-shop office, by one accustomed to all details, as practical machinist, draughtsman and book-keeper. Address, Machinist Book-keeper, care AMERICAN MACHINIST.

Wanted—A situation by a competent machinist, who is also a good draughtsman, has had experience as foreman, and in building file cutting machinery. Address—P. O. Box 577, Beaver Falls, Pa.

Wanted—A shafting turner. Wanted, a man who has made the turning of shafting a specialty for a long time. State experience, references and wages expected. None but experts need apply. Address, Medart Patent Pulley Co., St. Louis, Mo.

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Wanted—A strictly reliable and competent man, to design and superintend the production and manufacture of articles combined of wood and iron, in which a practical knowledge of the working of both is required; and also competent to estimate costs and manage men. Give age, former business, and references. Address H N. Kneeland, care Azro Goff, 150 Nassau Street, New York.

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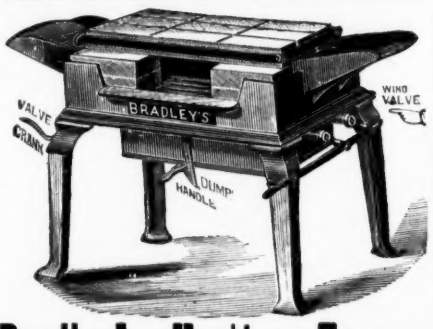

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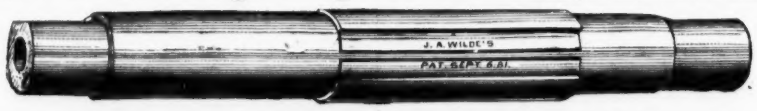

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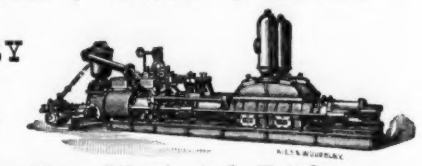

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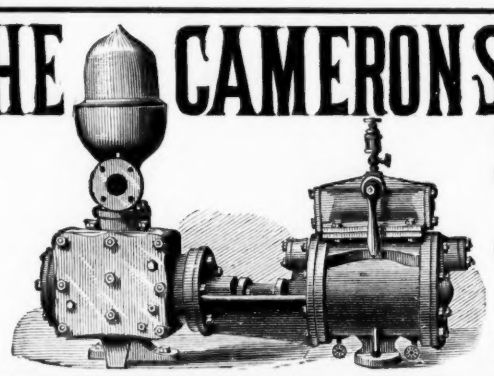

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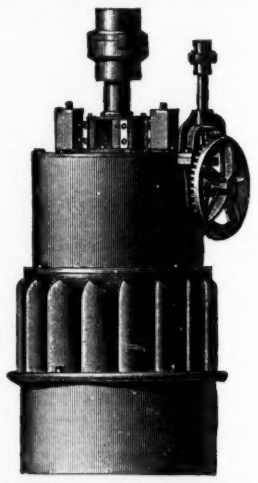

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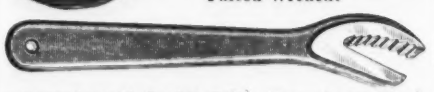

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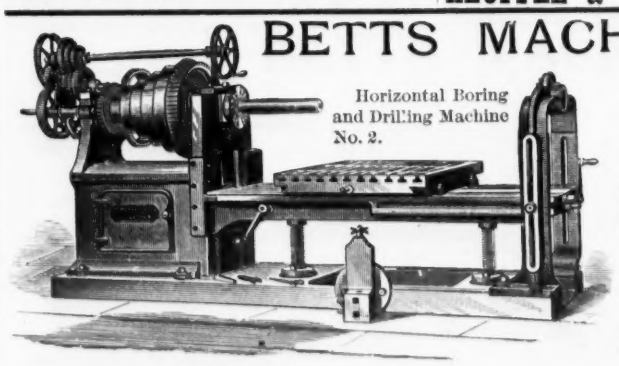

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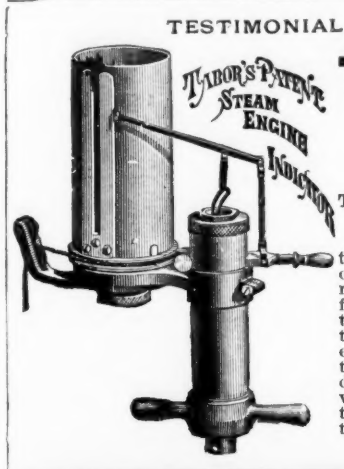

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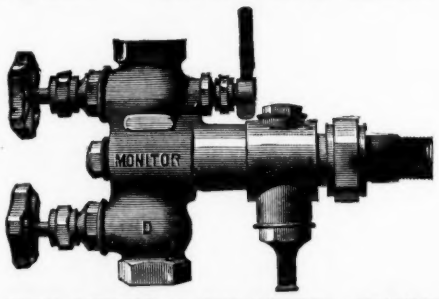

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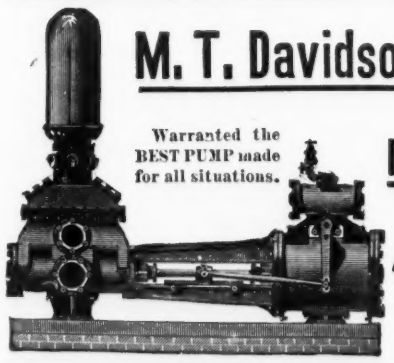
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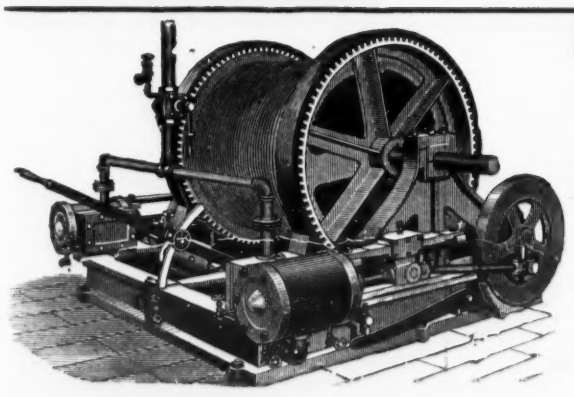
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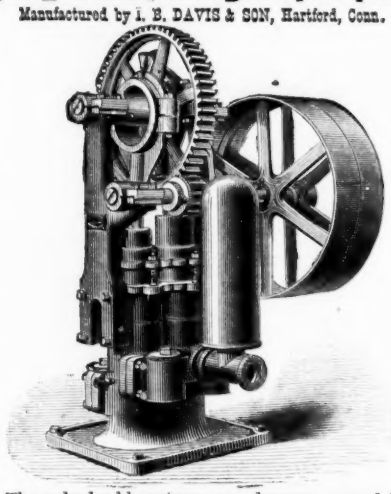
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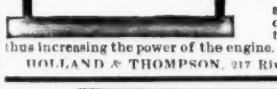
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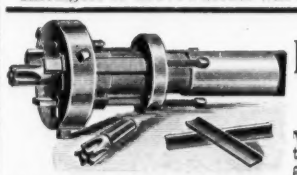
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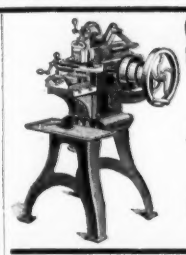
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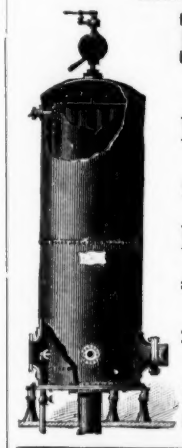
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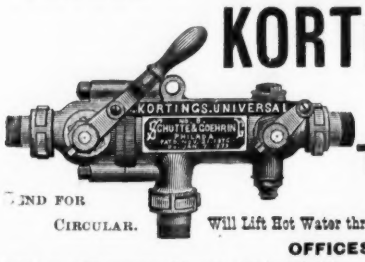

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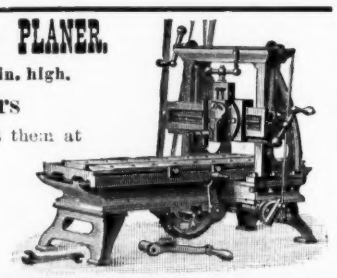

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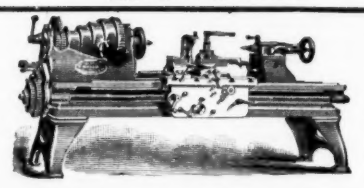

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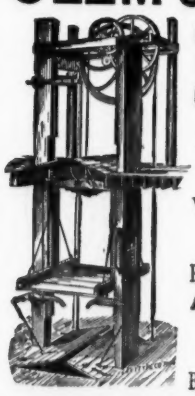

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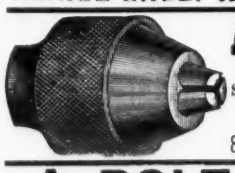

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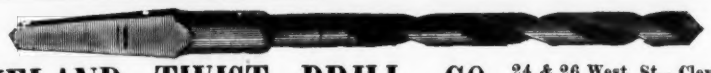

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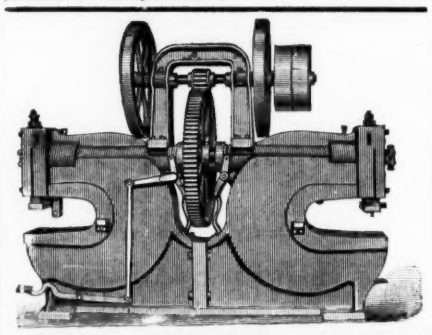

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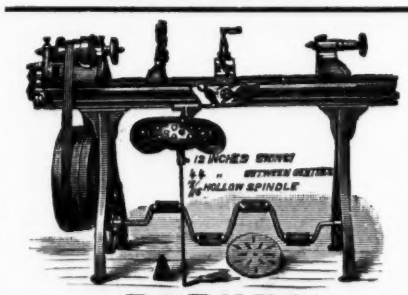

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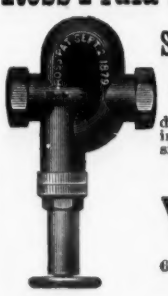

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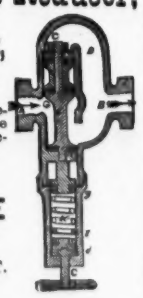

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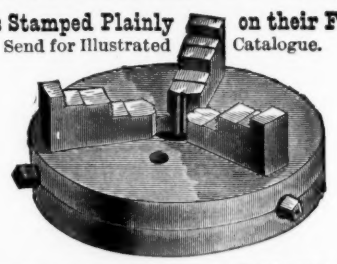

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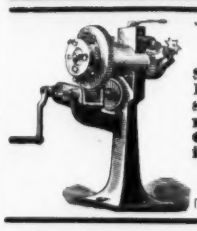

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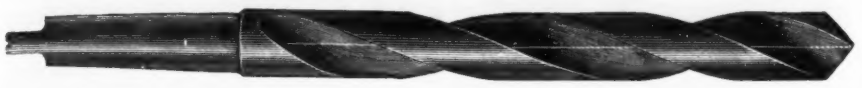

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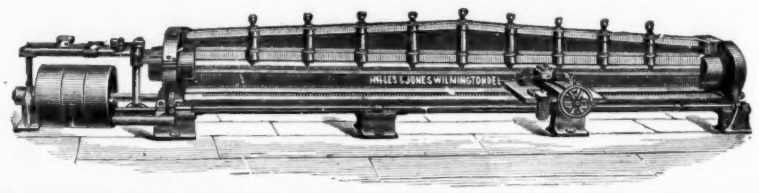

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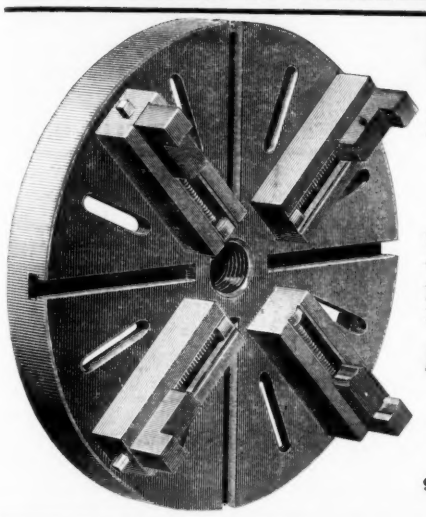

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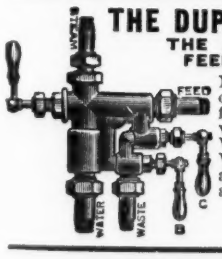

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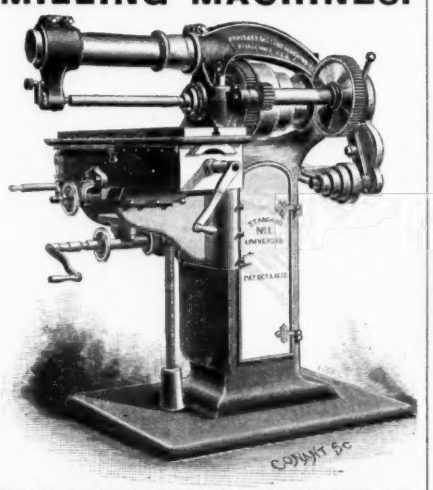

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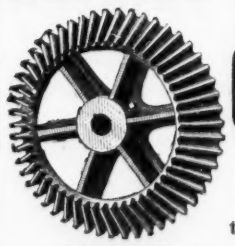

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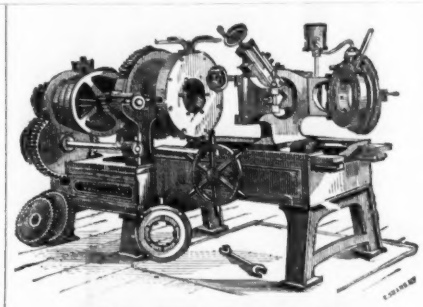

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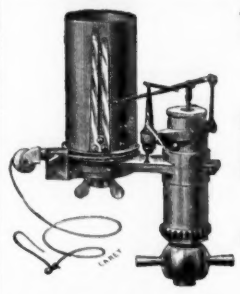

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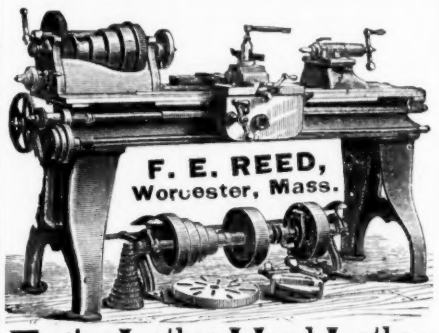

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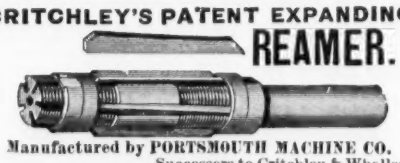

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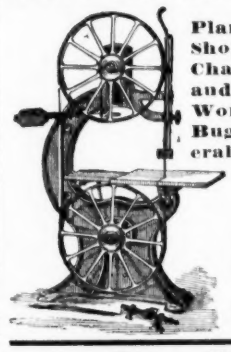

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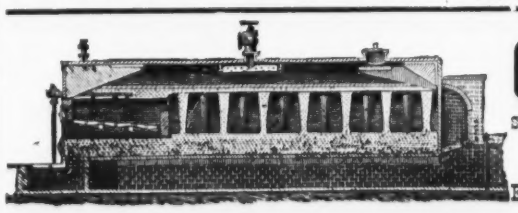

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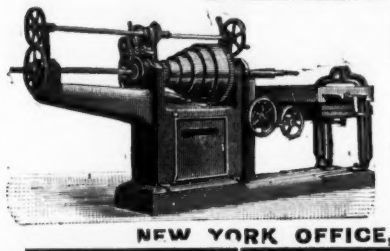

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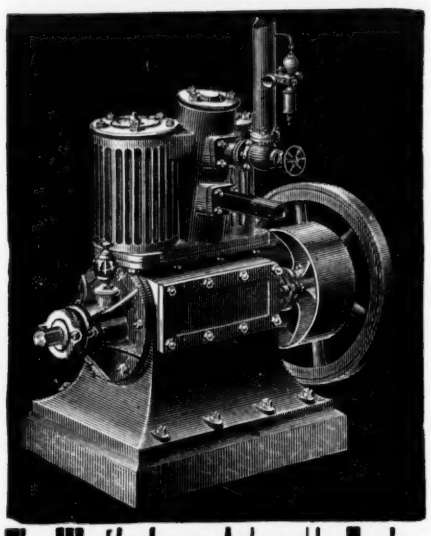

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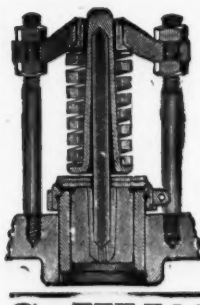

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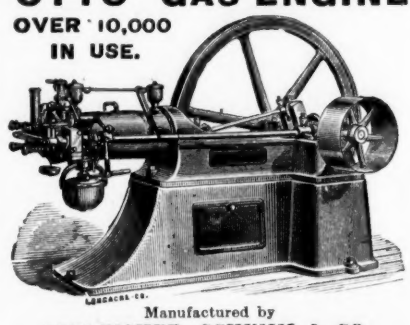

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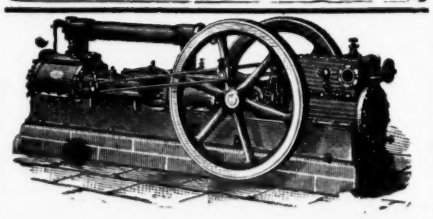

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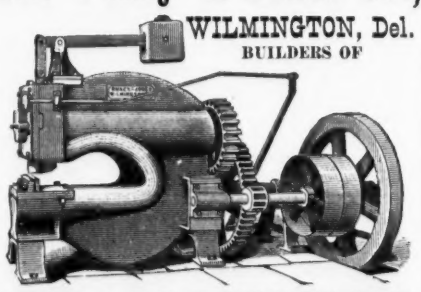

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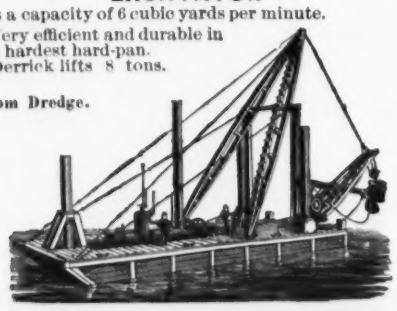

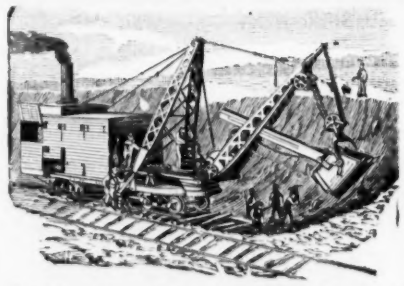

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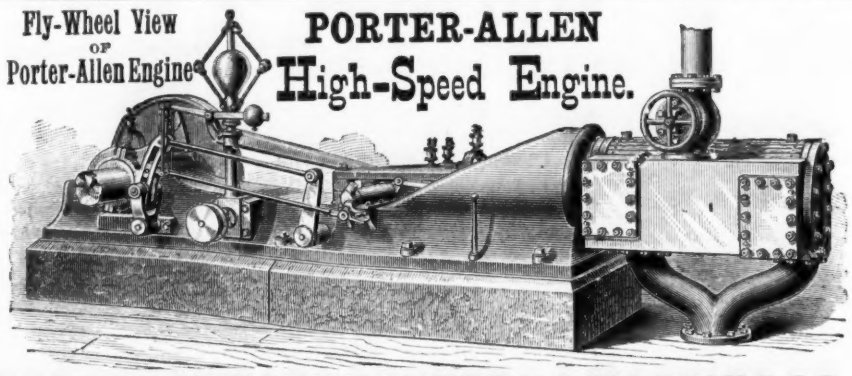

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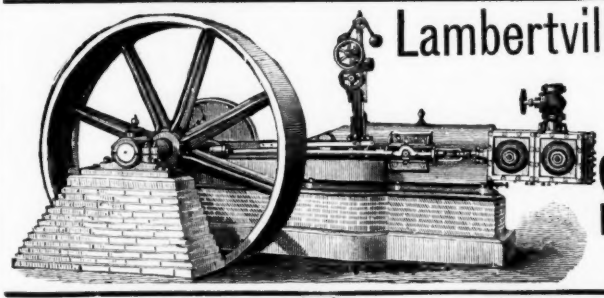

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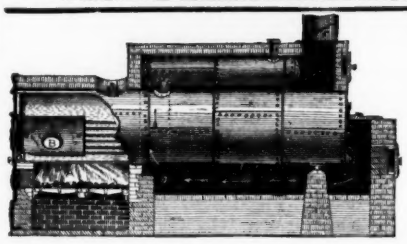

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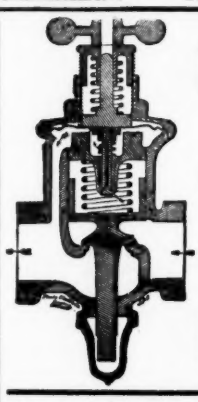

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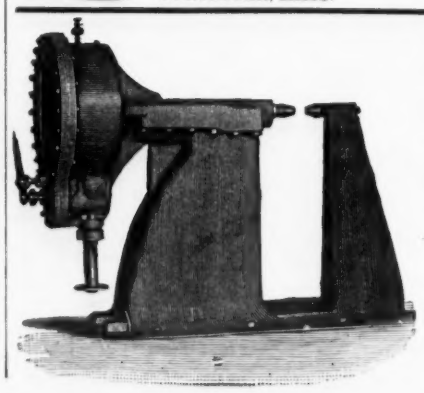

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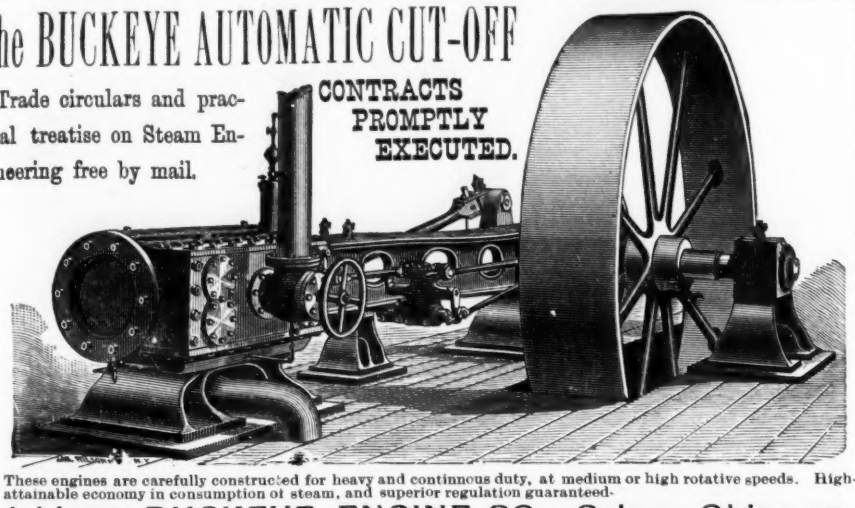

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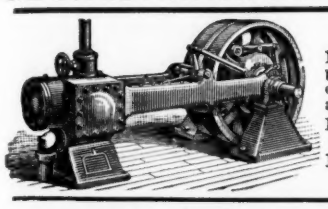

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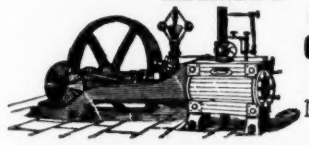

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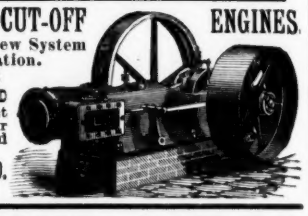

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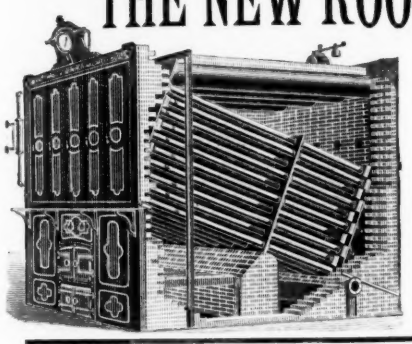

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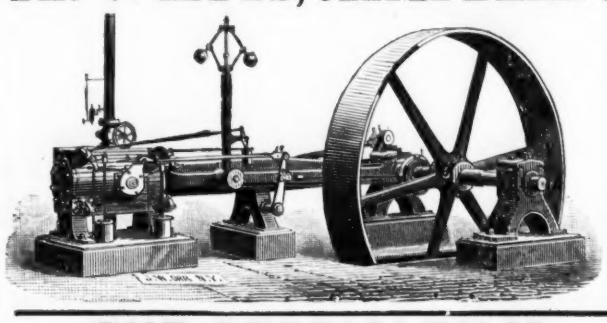

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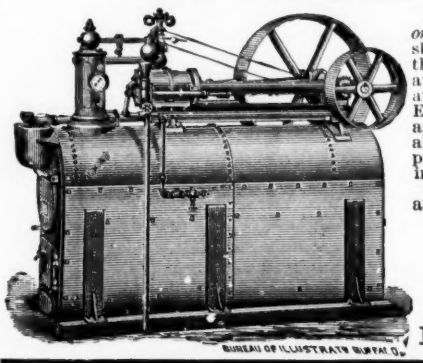

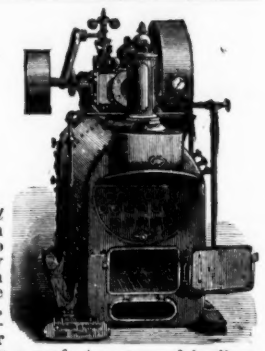

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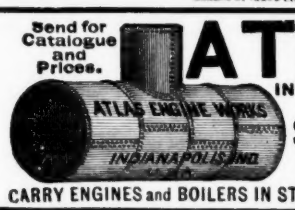

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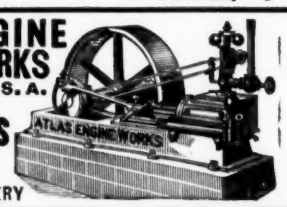

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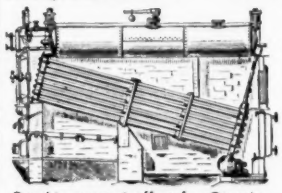

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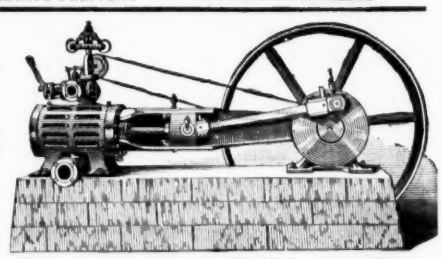

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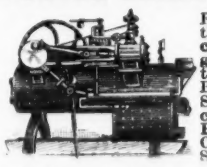

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One Iron Planer, to plane 8 feet x27x27 inch.

One 36 in. Car Wheel Borer, very good order.

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One Combined Power Punch and Shears, to punch ⅝ and ½, and shear ½ in. iron.

One Car Axle Lathe, Fitchburg Machine Co.

One 12 in. Shaper, Lowell Machine Shop.

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Two 4 in. Spindle Drills.

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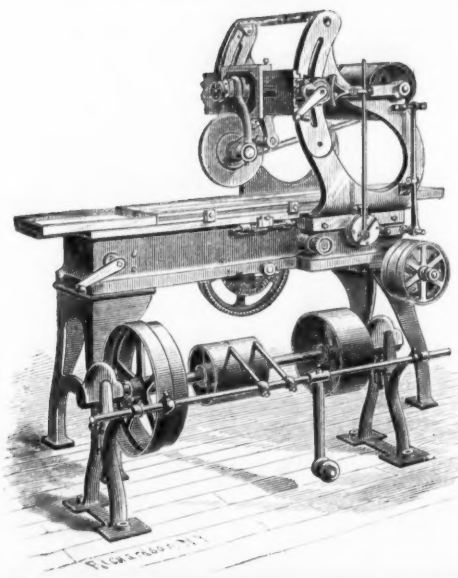

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The bridge has longitudinal motion on the tracks, and the trolley transverse motion on the bridge, so that the load may be picked up at any point between the tracks, raised to any height, and laid down at any other point.

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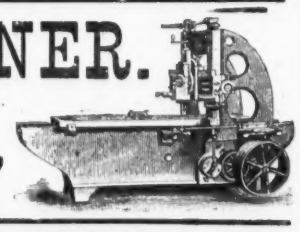

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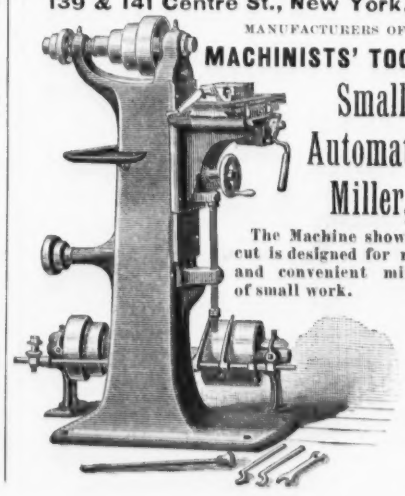

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The Machine shown in cut is designed for rapid and convenient milling of small work.

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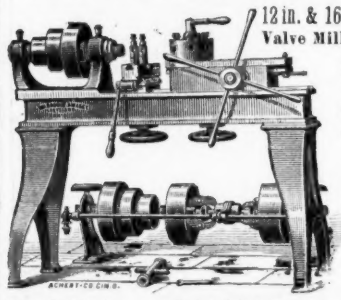

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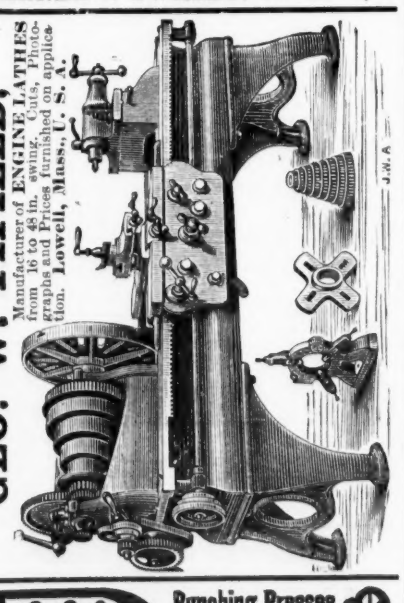

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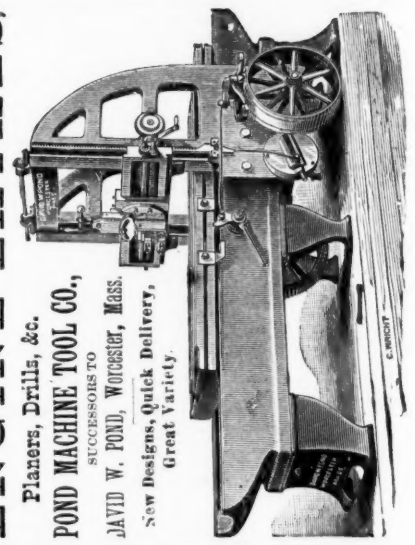

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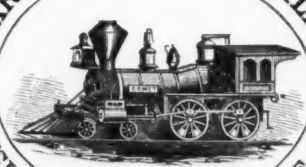

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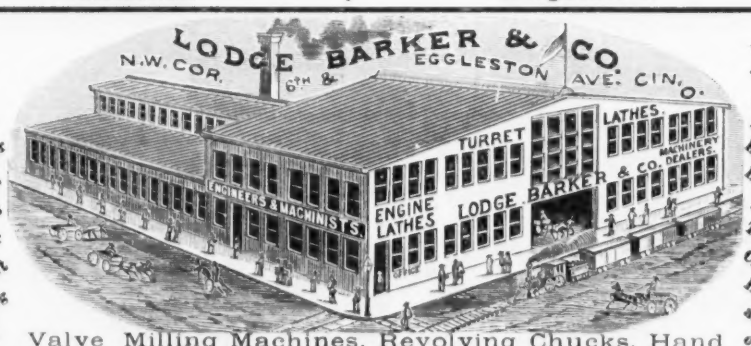

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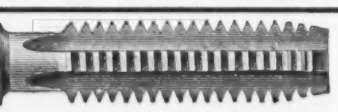

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